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Royal Commission on National Passenger Transportation

***Transportation for People with Disabilities:
A Policy Review and Analysis***

Hickling Corporation
March 1991

RR-01





Opinions expressed are those of the
author and not necessarily those of
the Royal Commission on National
Passenger Transportation.

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TRANSPORTATION FOR PEOPLE WITH DISABILITIES: A POLICY REVIEW AND ANALYSIS

Prepared for:

ROYAL COMMISSION ON PASSENGER TRANSPORTATION

HICKLING

Hickling Corporation
Practice in Disability and Aging

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CHAPTER 1 INTRODUCTION

The 19th and more than half of the 20th century witnessed the provision of medical and institutional care as the cornerstone of public policy regarding physical and mental disability. In the late 1950s, however, the philosophical basis of public policy shifted to that of fostering the integration of people with disabilities into the flow of daily life. While medical and living arrangements remain important policy considerations, they are now viewed less as ends in themselves and more as a means of enabling the disabled population greater independence and participation in the activities of day-to-day living.

The philosophical shift in the basis of policy follows from a recognition of the socially and economically damaging effects of institutional living, including: isolation; loneliness; unemployment; poverty; a low sense of self-worth and self-confidence; and discrimination. The range of policy instruments has expanded accordingly to encompass virtually any means by which to loosen the institutional bonds of disability. The focus of policy now includes rehabilitation; education and training; labour market and employment practices; architectural design and construction; transportation; advanced technology; research and development; and the consideration of constitutional and human rights.

The recognition of discrimination as an impediment to disabled individuals in seeking to achieve economic equality -- and the identification of human rights as a valid remedy -- stemmed initially from observed *de jure* discrimination with respect to the disabled in labour markets. Both the Canadian Charter of Human Rights and the Human Rights Act specifically prohibit discrimination against the disabled alongside groups identified by age, sex, race and religion.

The disabled community and its advocates have been quick however to extend the concept of non-discrimination to areas where design and technology create *de facto* barriers to the use of public services. This view of discrimination adds a dimension to policy development that is especially difficult in the case of passenger transportation. Studies and experience demonstrate that where design or technological barriers make it impossible for disabled people to use a conventional mode of public transportation (commuter rail, for example), it can be less costly and more effective to provide separate, specialized service (such as door-to-door vans) rather than make architectural and technological modifications to the inaccessible mode. If this practice is to be regarded as discriminatory, however, the only policy response that eliminates discrimination without reducing the overall level of mobility in the disabled population is to provide both the necessary architectural modifications and provide the specialized service. This is because of the sizeable number of disabled people that cannot get to and from terminals and bus stops because of debility, poor proximity or both and for whom the design modifications are thus of no use.¹

¹ Home and destination-based feeder/distributor service to fully accessible fixed-route systems represents a potential middle-ground. These services are themselves very costly however and they can exceed the cost of door-to-door service itself. As well, feeder services require interchanges that exceed the physical capabilities and travel desires of many disabled people (see later).

The provision of both fully accessible conventional passenger transportation and specialized service has important budgetary implications for the public sector and for private firms (such as the intercity bus industry). The high cost of pursuing both approaches implies an apparent choice between fully accessible public services versus maximum mobility. Yet in policy decisions where the choice has been brought to the test, social and political pressures have often led governments to attempt both. In these cases, the question of choice has been reduced to deciding (i) the rate of conversion to fully accessible passenger facilities, and (ii) the quality of specialized service to provide. Recent passage of the Americans with Disabilities Act in the United States represents an important case in point. It remains unclear whether resources and innovation can be sufficient to pursue both approaches while at the same time ensuring an adequate level of passenger services at prices disabled people can afford.

IMPLICATIONS FOR THE ROYAL COMMISSION

In virtually every aspect of passenger transportation, the Royal Commission will need to consider the implications of alternative policies from the perspective of people with physically and mentally disabling conditions. For modes under federal jurisdiction, the Commission will need to address the question of whether to adapt conventional transport; at what rate; and for whom. The question "for whom" reflects the heterogeneity of the disabled population. Modifications designed to enable blind people to use commuter rail services, for example, do nothing for those unable to use steps. The Commission will also need to address the role of specialized transportation and the associated quality of service.

Through its research and development functions, the federal government has an important influence on the quality of passenger transportation under provincial and local jurisdiction as well. Moreover, local and provincial developments will inevitably influence federal choices. The Commission will thus need to be aware of provincial and local developments.

PLAN OF THE PAPER

This paper provides a framework within which the Commission can consider the question of disability in relation to the wide array of issues to be addressed with regard to passenger transportation generally.

The paper is presented in five Chapters. Chapter 2 provides demographic information with special focus on the relationship between disability and passenger transportation. Chapter 3 analyzes the economic, social and legal issues underlying the provision of passenger transportation to people with disabilities. It is shown how the questions of economics and non-discrimination (human rights) are interwoven and the way in which this effects the nature of policy choices. Chapter 4 presents a review of the technical evidence for each passenger transportation system. Finally, Chapter 5 presents a framework and evaluation of specific policy choices.

CHAPTER 2 THE DEMOGRAPHICS OF DISABILITY IN PASSENGER TRANSPORTATION

In 1990, an estimated 3.0 million Canadians aged 15 and over -- 14.7 percent of the general population² -- had some form of physical or mental impairment which limited their participation in one or more major life activities.³ By the year 2000, at projected rates of population growth, the number of disabled Canadians is expected to grow to 3.7 million.

DISABILITY, TRANSPORTATION AND TRAVEL

However, not all of those defined as disabled according to the definition outlined above actually experience limitations in the use of passenger transportation. Many can access terminals, stations and bus stops; read and understand schedules; climb stairs; keep their balance on a moving vehicle; and, in short, perform the physical and mental tasks necessary to make effective use of passenger transportation.

A Functional Definition of Transportation-Related Disability

A more appropriate definition of disability from the viewpoint of passenger transportation includes persons who, because of physical or mental debility, cannot use one or more passenger transportation services or experience more than average difficulty doing so. This definition includes elderly persons for whom public transportation or private cars (as driver or passenger) are difficult or impossible to use because of the natural effects of aging. Under this definition of transportation-related disability, an estimated 1.9 million Canadians, some 9.5 percent of the general public, are hindered in the use of passenger transportation. Of the 1.9 million, 79 percent live in urbanized areas while just over one-fifth live in rural districts (Table 1).

As shown in Table 2, an estimated 7.1 percent of the Canadian adult transportation disabled population, fully 133,000 persons, use a wheelchair or walker all or some of the time. Some 22.2 percent have sight-related impairments of whom 42,000 people are legally blind. An estimated 650,000 Canadians exhibit hearing impairments, and speech-related disabilities affect an estimated 160,000 people, more than eight percent of the general population. Mental disability among the transportation-disabled ranges from learning impairments to high-level brain disorders. Estimates of the number of Canadians for whom one or more mental conditions limit their use of passenger transportation numbers 714,000, almost 40 percent of the total transportation-disabled public (and 3.6 percent of the public at-large).

² Unless otherwise stated, statistics in this report relate to Canadian residents aged 15 and over. Issues regarding disabled children are dealt with only with regard to the transportation problems of disabled adults travelling with disabled children.

³ Hickling Corporation, from statistics in the Health and Disability Data Base prepared by the Hickling Corporation for the Transportation Development Centre, Transport Canada 1990. The principal data source is the Health and Activity Limitation Survey (HALS) of 1987. With a sample of 140,000 households, HALS is the most extensive survey of disability in the world.

TABLE 1:
NUMBER OF TRANSPORTATION-DISABLED PERSONS,
BY AREA OF RESIDENCE (1990)

	All Persons (in Millions)	Transportation-Disabled Persons (in Millions)
Persons Aged 15 and Over	20.5	1.9
Area of Residence	(in Percent)	(in Percent)
Large Urban Areas	41.3	37.3
Small Urban Areas	37.1	41.4
Rural Areas	21.6	21.3
TOTAL	100	100

SOURCE: Hickling Corporation, from Health and Activity Limitation Survey, 1987, with projections to 1990.

NOTE: Percentages may not add due to rounding.

**TABLE 2:
NUMBER OF TRANSPORTATION-DISABLED PERSONS,
BY TYPE OF DISABILITY (1990)**

TRANSPORTATION-DISABLED PERSONS		
	Number	Percent ¹
All Transportation-Disabled Persons Aged 15 and Over	1,879,615	100
Wheelchair/Walker	132,660	7.1
Sight Impaired	417,990	22.2
Blind	42,176	2.2
Hearing Impaired	648,780	34.5
Speech Impaired	159,843	8.5
Mentally Disabled	714,398	38.0
Disability Unspecified	37,052	2.0

SOURCE: Hickling Corporation, from Health and Activity Limitation Survey, 1987, with projections to 1990.

¹ Figures will add to more than 100 percent due to people with multiple disabilities. Figures include persons living in institutions. Figures exclude those confined to the home, an estimated 37,600.

Functional Disabilities in the Use of Passenger Transportation

People with disabilities in the use of passenger transportation services fall into two distinct functional groups, (i) those unable to use one or more services, and (ii) those able to use the service in question but for whom design, technological and operational factors make doing so difficult, possibly inhibiting travel. Since the costs and benefits of adapting passenger transportation services can vary substantially depending upon which of the two groups individuals belong, the distinction is an important one from a policy perspective.

Four major surveys conducted between 1978 and 1987⁴-- two Canadian and two in the United States -- find consistently that among those with transportation-related disabilities between 18 percent and 22 percent are unable to use one of more modes of conventional passenger transportation -- about 400,000 Canadians in 1990. For most of these individuals, getting to and from stations, terminals and bus stops and using stairs and steps represent a dominant problem; since these are common procedural and design attributes of virtually all modes, an inability to use one typically implies an inability to use all. Most persons in this category are identified as severely physically disabled; most either use a wheelchair, walker or artificial limb or suffer severe rheumatoid arthritis.⁵

In comparison with the effects of physical disabilities, relatively little is understood about the transportation-related effects of mental disability and speech-related impairments. The more recent Canadian surveys indicate that both have been sharply under-estimated in their deleterious impacts on the use of passenger transportation. The need to read and understand schedules and complex networks (involving rapid interchanges at airports and bus terminals, for example) is now thought to severely inhibit travel among a sizeable, though unquantified number of people with cognitive and speech-related disabilities.

Although federal research and development activities influence all modes of passenger transportation,⁶ direct jurisdiction extends to inter-provincial aviation, ferry services, commuter rail, intercity rail and intercity bus transportation. As shown in Table 3, an estimated 302,000 disabled Canadians cannot use one or more modes of long-distance public passenger transportation because of design, technology and cognitive factors. The use of stairs is an insurmountable problem for a large proportion of this

⁴ The surveys are, *Health Information Survey*, U.S. Department of Health, Education and Welfare, 1977; *Survey of Transportation Handicapped Persons*, U.S. Urban Mass Transportation Administration, 1978; *Canadian Health and Disability Survey*, Statistics Canada, 1983/84; and *Health and Activity Limitation Survey*, Statistics Canada, 1987

⁵ Arthritis is the most common disabling condition and source of activity limitation in Canada and most other Western nations. An estimated 8 percent of all individuals with arthritis cannot use one or more modes of passenger transportation.

⁶ The Disability Research Program of the federal Transportation Development Centre in Montreal conducts research and development activities into every mode of travel, including private automobiles, urban buses, taxis and specialized transportation. In addition, Transport Canada conducts demonstration programs in the use of accessible urban taxis and makes grants-in-aid to the Canadian bus manufacturing industry for the development of accessible urban buses.

TABLE 3:
TRANSPORTATION-DISABLED PERSONS PREVENTED
FROM TAKING INTERCITY TRIPS (1986)

Description	Number of Persons	Percentage of Total Population
Total Prevented from Taking Long-Distance Trips	302,000	1.5
Use Wheelchair or Walker	40,000	0.20
Hearing Impaired	74,000	0.37
Seeing Impaired	77,000	0.38
Legally Blind	8,000	0.04
Mentally Impaired	25,000	0.12
Unable to Use Stairs	85,000	0.42
Difficulty Using Stairs	121,000	0.60
Difficulty Using Stairs, Walking 400 m and Standing 20 minutes	161,000	0.80

SOURCE: Hickling Corporation, from Canadian Health and Disability Survey, 1986.

group. More recent research has also identified the speaking and hearing requirements of most airport, rail and bus terminal operations as a major impediment for disabled people with speech and hearing-related impairments.

Travel Patterns

People with transportation-related disabilities make 46 percent fewer daily trips than the public at-large (Table 4). They rely more on public transportation; and they are more dependent upon high cost modes, such as taxis. As shown in Table 4, as a proportion of their total daily travel, people with transportation-related disabilities make eight-times more use of taxis than the population generally. Although disability makes door-to-door transportation more attractive than fixed-route passenger transportation, thus increasing the propensity of disabled people to give weight to this attribute of service, people with disabilities have substantially smaller incomes than the public at-large, thus dampening their willingness to devote a significant share of their disposable income to transportation. Discriminant choice models have attributed the eight-fold higher use of taxis among the disabled principally to the lower availability of private transportation (automobile as driver) and secondarily to the physical inaccessibility of fixed-route passenger transportation -- principally because of problems in the use of stairs among those with severe physical disabilities and problems understanding schedules and networks among those with higher-level mental disorders.⁷

SOCIO-ECONOMIC CHARACTERISTICS OF PEOPLE WITH TRANSPORTATION-RELATED DISABILITIES

To be sure, people with disabilities are not as well served by passenger transportation and other public facilities and services as members of the public at-large and this helps explain the lower activity rates reflected in their daily travel patterns. A much wider range of social and economic factors must be considered, however, in understanding their lower rates of travel and participation in life activities. Many are elderly and aging is associated with lower activity rates generally. Most have lower levels of educational attainment. For many, health and disability prevent them from entering the labour market. And for the majority, very low incomes prohibit a full and active life.

The Elderly and Women Among the Disabled

The likelihood of becoming transportation-disabled increases sharply with age, as indicated in Table 5. Whereas 13.6 percent of the general population was aged 65 or more in 1990, fully 46 percent of those with transportation-related disabilities were over the age of 65. Among all persons over the age of 65, an estimated 30 percent reported transportation-related disabilities in the Canadian Health and Activity Limitation Survey of 1987; among those beneath the age of 65, an estimated 5.7 percent reported disabilities that prevented or limited their use of passenger transportation.

⁷ David Lewis, *The Economics of the Serving the Travel Needs of Handicapped Persons*, Unpublished Ph.D dissertation, London School of Economics, London, 1985

**TABLE 4:
TRIPS TAKEN BY TRANSPORTATION-DISABLED PERSONS,
BY MODE, (1986)**

Mode	All Persons	Transportation-Disabled Persons
Total Number of Trips per Month	55	30
Percent of Total Trips		
Personal Vehicle as Driver	63	49
Personal Vehicle as Passenger	16	16
Public Transportation	15	18
Taxi	1	8
Specialized Service	--	1
Walking	5	7

SOURCE: Hickling Corporation, from the Canadian Health and Disability Survey and the U.S. Urban Mass Transportation Administration.

NOTE: Excludes those under 15 years of age and persons confined to the home.

TABLE 5:
NUMBER OF PERSONS AGED 15 AND OVER WITH
TRANSPORTATION-RELATED DISABILITIES,
CLASSIFIED BY AGE AND SEX (1990)

Persons Aged 15 and Over	All Persons (in Millions)	Transportation-Disabled Persons (in Millions)
	(in percent)	(in percent)
Sex		
Female	48.9	55.6
Male	51.1	44.4
TOTAL	100	100
Age Category (in years)	(in Percent)	(in Percent)
15 - 34	41.4	12.3
35 - 54	33.6	22.5
55 - 64	11.3	19.4
65 - 69	4.9	10.9
70 - 79	6.3	21.4
Over 80	2.4	13.5
TOTAL	100	100

SOURCE: Hickling Corporation, from Health and activity Limitation Survey, 1987, with projections to 1990.

NOTE: Percentages may not add due to rounding.

The higher longevity rates among women is reflected in the demographics of disability. Whereas the number of males and females in the general population is closely balanced, the number of disabled women exceed the number of disabled men in the ratio of 1.3:1, as shown in Table 5. It is not known whether the incidence of disability is higher among women than men.

Educational Attainment

People with transportation-related disabilities (like the disabled population generally) are more poorly educated, are less likely to work and have radically lower incomes than the population at-large. According to the Health and Activity Limitation Survey of 1987⁸, 39 percent of the transportation-disabled population have acquired no more than a primary level education. Whereas 43.3 percent of the general adult population in 1987 had acquired a post-secondary education or higher, only 25.1 percent of the disabled public had reached that level.

Labour Force Participation and Employment

Lower educational attainment is reflected in lower labour market activity rates among the disabled, although education is only one causal factor in explaining the group's structurally lower rate of employment. Among Canadians of working age, Table 6 indicates that 75 percent were active in labour market; 67 percent had jobs in 1987 and some eight percent were unemployed. By contrast, only 38 percent of working-aged people with transportation-related disabilities were actively seeking work in 1987, exactly half the labour force participation rate of the general public. Less than 30 percent held paying jobs.

It is interesting to note in Table 6 that among those disabled persons actively seeking work in 1987, the rate of unemployment was slightly lower than the rate among the population at-large (6.4 percent versus 8.0 percent). These statistics reflect the high rate of employment in rehabilitation and protected workshops among the disabled. These jobs are typically part-time and hourly wage rates lie sharply beneath rates in the labour market-proper.

Inadequate transportation and inability to get to work do not arise as significant reasons for low labour force participation and employment rates among disabled persons of working age. The principal reasons people with disabilities give for not working are disability, inability to work and home and family responsibilities. Several surveys over the past 15 years have found no more than one or two percent of disabled respondents citing lack of transportation as a reason for not working.⁹ Though necessary as part of an overall policy of improving the living standards of people with disabilities, better passenger transportation systems alone will do little to enhance their economic and social well being.

⁸ Unpublished analysis prepared by the Hickling Corporation.

⁹ Surveys include the Canadian Health and Disability Survey of 1984 and surveys of the U.S. Department of Transportation conducted in the late 1970s and early 1980s.

TABLE 6:
EMPLOYMENT STATUS OF TRANSPORTATION-DISABLED
PERSONS OF WORKING AGE

Persons Aged 15 - 65	All Persons (in Millions)	Transportation-Disabled Persons (in Millions)
Employment Status	(in Percent)	(in Percent)
Employed	66.8	29.8
Unemployed	8.0	6.4
Not in Labour Force	25.1	62.1
Unknown Status	0.2	1.6
TOTAL	100	100

SOURCE: Hickling Corporation, from Health and Activity Limitation Survey, 1987, with projections to 1990.

NOTE: Percentages may not add due to rounding.

Income and Earnings

Lower rates of educational attainment and employment are reflected in lower incomes among the disabled population. As shown Table 7, the median personal income of people with transportation-related disabilities lies beneath \$5,000.00 annually (1987 dollars). Whereas 59 percent of all adult Canadians (aged 15 and over) report personal incomes beneath \$15,000.00 almost 80 percent of the disabled fall into this category. It is well known that travel and income are causally related. Again, therefore, even the most effective passenger transportation systems for people with disabilities will, alone, do little to enhance the well-being and standard of living of this group.

TABLE 7:
NUMBER OF PERSONS AGED 15 AND OVER WITH
TRANSPORTATION-DISABILITIES,
CLASSIFIED BY GROSS PERSONAL INCOME (1990)

Gross Personal Income (1987 Dollars)	All Persons (in Percent)	Transportation-Disabled Persons (in Percent)
No Personal Income	12.4	10.2
1 - 4,999	16.4	15.9
5,000 - 9,999	17.7	35.9
10,000 - 14,999	12.3	15.0
15,000 - 24,999	17.9	12.3
Over 25,000	23.0	10.5
TOTAL	100	100

SOURCE: Hickling Corporation, from Health and Activity Limitation Survey, 1987, with projections to 1990.

NOTE: Percentages may not add due to rounding.

CHAPTER 3 AN ECONOMIC AND SOCIAL FRAMEWORK FOR POLICY CHOICE

A practical framework for guiding the economic analysis of transportation improvements for people with disabilities recognizes two conceptually generic policy approaches, as follows:

- o Approaches designed to modify conventional passenger transportation systems to accommodate those unable to use them and those who can only use them with difficulty; and
- o Approaches designed to provide specialized service as a substitute for regular passenger transportation systems. The provision of these, typically door-to-door services, applies as either substitutes or complements (ie, feeder services) to urban bus and subway transportation systems; commuter rail systems; and potentially intercity bus services over shorter distances. They rarely represent a realistic substitute for aviation services; they do, of course, represent a potentially important complement in providing people with disabilities access to and from airports.

Each approach has its unique economic characteristics from the viewpoint of both costs and benefits, all closely linked to demand.

THE COSTS OF ALTERNATIVE APPROACHES

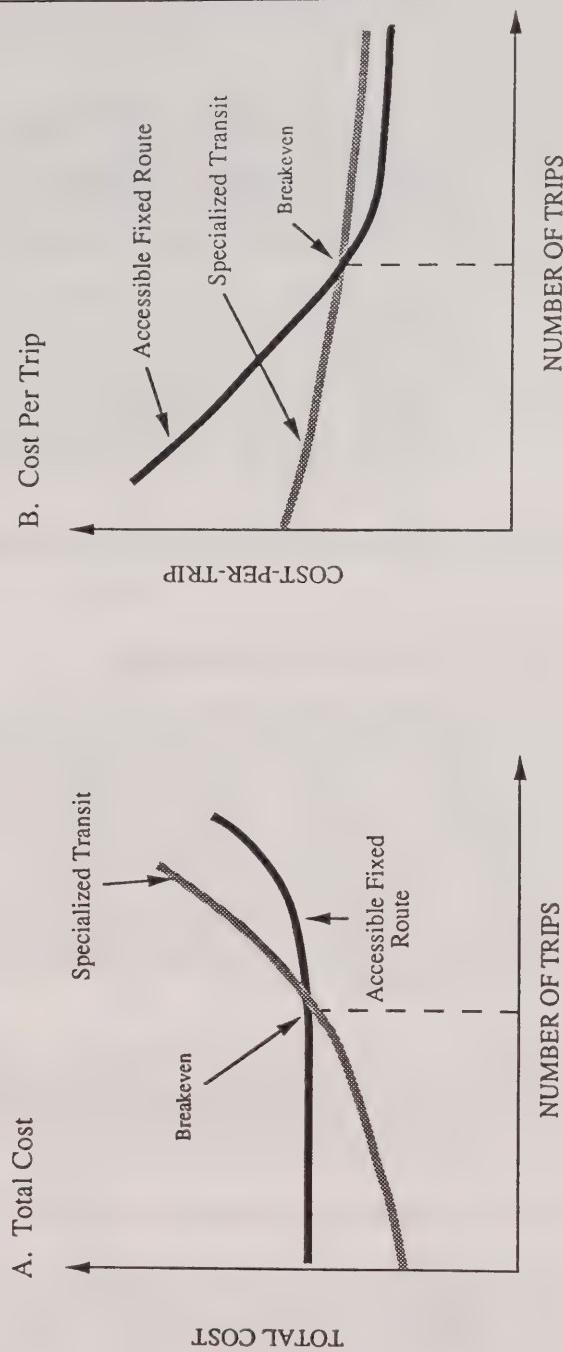
The cost of adapting conventional passenger transportation systems is broadly fixed, regardless of the use made of them by people with disabilities. The cost of specialized, door-to-door transportation, on the other hand, is relatively flexible; it depends heavily on the number of disabled persons who choose to use it. As shown in Figure 1A, this means that below a "breakeven" level of trip demand, policies that emphasize door-to-door specialized services will cost less than those requiring modifications to conventional passenger transportation systems. Cost-per-trip, a measure of cost-effectiveness, displays a similar profile. Above a "breakeven" level of trip demand, modifying conventional passenger transportation would be more cost-effective than specialized transportation since the cost-per-trip of modifying conventional passenger transportation systems declines as more people use it. Cost-per-trip of specialized transportation, on the other hand, is relatively stable with respect to the volume of demand (Figure 1B).

Clearly, the comparative costs and cost-effectiveness of modifying conventional passenger transportation systems and providing specialized transportation turn on the rate at which disabled people elect to use conventional transit. The breakeven demand level also depends heavily upon the segment of the disabled population being addressed, namely those unable to use the service versus those able to do so, albeit with physical or cognitive difficulty.

Persons Unable to Use Conventional Passenger Transportation

Modifications aimed at making conventional passenger transportation systems accessible to those now *unable* to use them are the most costly and the breakeven demand requirements are thus relatively high. Since this segment of the transportation-disabled population represents only one-fifth of the entire group, it means that achieving the breakeven demand level requires a rate of trip making

FIGURE 1:
THEORETICAL BEHAVIOUR OF COST AND COST-PER-TRIP OF ADAPTED
TRANSIT AND DOOR-TO-DOOR SPECIALIZED TRANSIT



among a minority of the target group that is disproportionately higher than that of the disabled and the general public at-large. The cost of accommodating this group is also disproportionately costly, often requiring the installation of elevators in stations and terminals; lifting and levelling devices on buses and trains; the provision of wheelchair securement areas; and modifications to restrooms in terminals and vehicles. Wheelchair securement and vehicle restroom adaptations can result in a loss of seating capacity unless rolling stock is added to the fleet to compensate. These and other major design and operational changes needed to accommodate those unable to use steps and stairs add additional pressure to achieve relatively high trip demands in order to make a policy of full accessibility to this group attractive from the viewpoint of comparative costs.

The breakeven demand requirement is also dependent upon the trip-length characteristics of the conventional mode in question. As rule, the shorter the average trip length, the higher the breakeven demand requirement will be in order to make access to the conventional mode comparatively attractive from a cost point of view. This is because the cost of the specialized transportation alternative varies almost proportionately with trip length. At the extreme, in spite of the high fixed cost of adapting airports and aircraft for those unable to use them now, the cost of specialized door-to-door surface transportation in lieu will clearly be very high indeed and comparatively more costly still. It has largely gone without saying that adapting airports and aircraft represents the correct policy response. In all other modes, the case is less clear. The evidence is reviewed later.

Breakeven demand requirements depend upon certain operational outcomes of making conventional passenger transportation fully accessible. If the demand by disabled people for conventional passenger transportation exceeds a certain level, the extra boarding times required for wheelchair users and other severely disabled persons can disrupt schedules, the cost of which can be measured either by the increased number of vehicles or trains needed to make up the schedule, or by the value of delays incurred by all passengers (including the disabled). (This cost is reflected in Figure 1A by the rising portion of the accessible fixed route curve). If demand among the disabled group is high enough to warrant fleet expansion, the added cost will require a further increase in demand to make such expenditures comparatively worthwhile. As shown later, it is not known, either theoretically or from practical experience, whether an equilibrium, a breakeven demand can eventually be reached under these dynamic circumstances.

Breakeven demand also depends upon the operational characteristics of specialized transportation which in turn influences its productivity and thus its cost. The productivity of specialized transportation is measured in the number of trips served per vehicle-hour. Clearly, for a given level of hourly cost (hourly wages, fuel and depreciation mainly), the more trips served per vehicle-hour the lower the overall cost-per-trip will be.¹⁰ The productivity of specialized transportation is heavily dependent upon trip length, with very long trips reducing the probability of serving multiple trips per hour. Productivity is also dependent upon the quality of service, such as the extent to which passengers must phone ahead for service and the extent to which the operator requires a minimum number of rides to form a run. Typically, achieving higher productivities means reducing quality of service from the passenger perspective. This in turn creates imbalances between the perceived quality of specialized transportation and the conventional passenger mode for which it is intended to

¹⁰ Indeed, cost-per-trip is simply hourly cost divided by trips per vehicle-hour.

"substitute." As shown later, achieving a perceived "equal service quality" increases the cost of specialized service a great deal more than previously thought necessary in the provision of such services. This in turn increases the relative attractiveness of making the conventional mode fully accessible. If, however, pressure arises to provide both full access to conventional passenger transportation and "equal quality" specialized service for those still unable to use regular passenger modes, costs clearly increase disproportionately.

Persons for Whom Passenger Transportation is Physically and Mentally Difficult

Modifications aimed at making conventional passenger transportation systems more effective for disabled people who can use them only with difficulty are considerably less costly and less operationally complex. Such steps include the provision of priority seating; non-slip flooring; more and better hand-holds; better signs for sight-impaired persons and appropriate information media for those with speech and hearing disabilities. Since individuals in this group are generally ambulatory, their use of passenger transportation systems will not cause disproportionate dwell times and thus no operational costs are to be expected. Breakeven demand levels thus lie substantially beneath those required of the severely disabled group. Moreover, since the group in question represents four-fifths of the transportation-disabled population as a whole, the achievement of breakeven demand levels does not require disproportionately high trip rates among this group.

THE BENEFITS OF ALTERNATIVE APPROACHES

Enhanced mobility, measured in the form of increased trip-making and less onerous travel conditions, represents the immediate policy objective of steps to improve passenger transportation for people with disabilities. On this basis, approaches with the greatest potential for easing travel difficulties and increasing the rate of trip-making among people with disabilities can be said to yield the greatest benefit.

A wide array of additional aims can be embraced by policy in this area. Whether to embrace them is itself an important policy decision. Indirect mobility-related objectives include the facilitation of a wider range of choice in employment opportunities, consumption activities, medical facilities and social undertakings for people with disabilities. These benefits are closely linked to trip making and while they can be hard to measure specifically, it can usually be assumed that if one approach generates more trip demands by people with disabilities than another, it is also likely to create more indirect benefits as well.

But policy can also embrace non-economic objectives, objectives that are not directly associated with mobility at all. These include the elimination of *de facto* discrimination in the provision of public services. A closely related aim is that of promoting the availability of all public facilities to individuals as a matter of civil and human rights, regardless of physical or mental condition. Success in achieving the latter objective has little or no connection to trip-making and mobility per se.

The Direct Benefits of Making Conventional Passenger Transportation Systems Accessible

Where conventional passenger transportation systems are improved for those who physically or cognitively can use them only with difficulty, the direct economic benefits fall into two categories, as follows:

- o Greater comfort, convenience and safety for those who used the system prior to the introduction of improvements; and
- o Greater trip-making and thus enhanced mobility by those who used the system prior to the introduction of improvements and by those who elected not to use the system prior to the introduction of improvements.

In terms of formal economic analysis, the two categories of benefit listed above correspond to areas A and B in Figure 2. The vertical axis in Figure 2 represents the economist's concept of "generalized cost." Generalized cost represents the sum of the monetary, time, effort and safety costs associated with travel, where time, effort and safety are expressed in monetary terms based upon users' willingness to pay for these attributes of travel.¹¹ Improvements in conditions for transportation-disabled persons can thus be characterized as reductions in generalized cost (from C₀ to C₁ in Figure 2, for example); depending upon the elasticity of demand, the reduction in generalized cost can be expected to result in greater trip-making (as represented by the demand curve in Figure 2).

Under the framework depicted in Figure 2, greater comfort, convenience and safety for those who used the system prior to the introduction of improvements corresponds to area A, namely the increase in consumer surplus to existing users. Greater trip-making corresponds to area B, the *change* in consumer surplus.

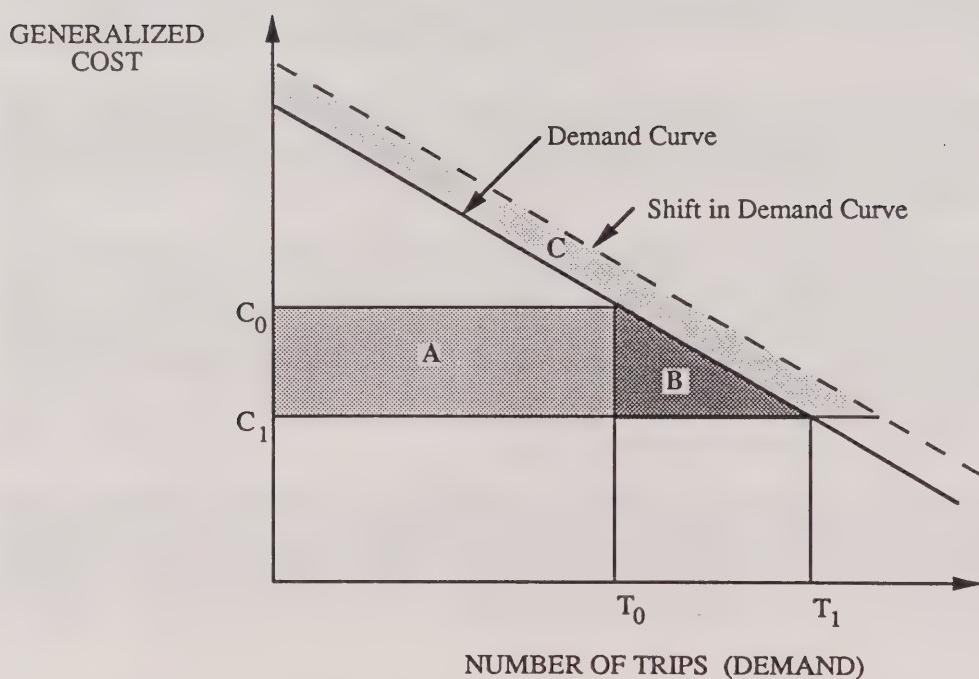
A third direct benefit arises if conventional passenger transportation systems are improved for those who physically or cognitively cannot use them at present, namely the increased trip-making and thus increased mobility by those who newly elect to use the system following its modification. In terms of formal economic analysis, this benefit is represented by area C in Figure 2, the additional consumer surplus created by a physical shift in the demand for passenger transportation among severely disabled persons.

The Direct Benefits of Specialized Transportation

The direct benefits of specialized transportation can fall into the same three categories as those outlined above for conventional passenger transportation; the service can be made more comfortable, convenient and safe for existing users or it can be extended to those previously unable or ineligible to use the service.

¹¹ See, P.B. Goodwin, *Human Effort and the Value of Travel Time*, Journal of Transport Economics and Policy, Vol X, No. 1, January, 1976

FIGURE 2:
**ECONOMIC BENEFITS OF ACCESSIBLE
CONVENTIONAL PASSENGER TRANSPORTATION**



A particular benefit often attributed to specialized transportation is the higher level of service inherent in door-to-door transportation. Door-to-door transportation is indeed a highly valued attribute of any mode of transport. It must be remembered however that specialized transportation can also involve trade-offs, including advance booking requirements, trip purpose restrictions, a limited geographic range of service and a higher fare than conventional transportation and so on. The actual benefits of specialized service will depend upon the way in which the system is configured and operated and peoples' preference for the service under such conditions. Ultimately, the best measure of the direct economic benefits of specialized transportation is the number of people who elect to use it and how often -- in short, the volume of trip making it generates for a given level of service and price.

COMPARING THE BENEFIT-COST PERFORMANCE OF ALTERNATIVE APPROACHES: THE QUESTION OF NON-DISCRIMINATION AND HUMAN RIGHTS

As shown later in this paper, the high cost of modifying conventional passenger transportation for those unable to use these systems today can often exceed the cost of specialized transportation, both in terms of total outlays and in terms of cost-per-trip. An important question thus emerges, namely whether the twin concerns of non-discrimination and human rights have a role to play in the evaluation of alternative policy alternatives. Using a branch of economic analysis known as "Law and Economics," (popularized in a joint program of law and economics at the University of Chicago) the Hickling Corporation has developed a framework within which this question can be considered systematically. A summary of the results follows.¹²

The Question of Intrinsic Human Rights

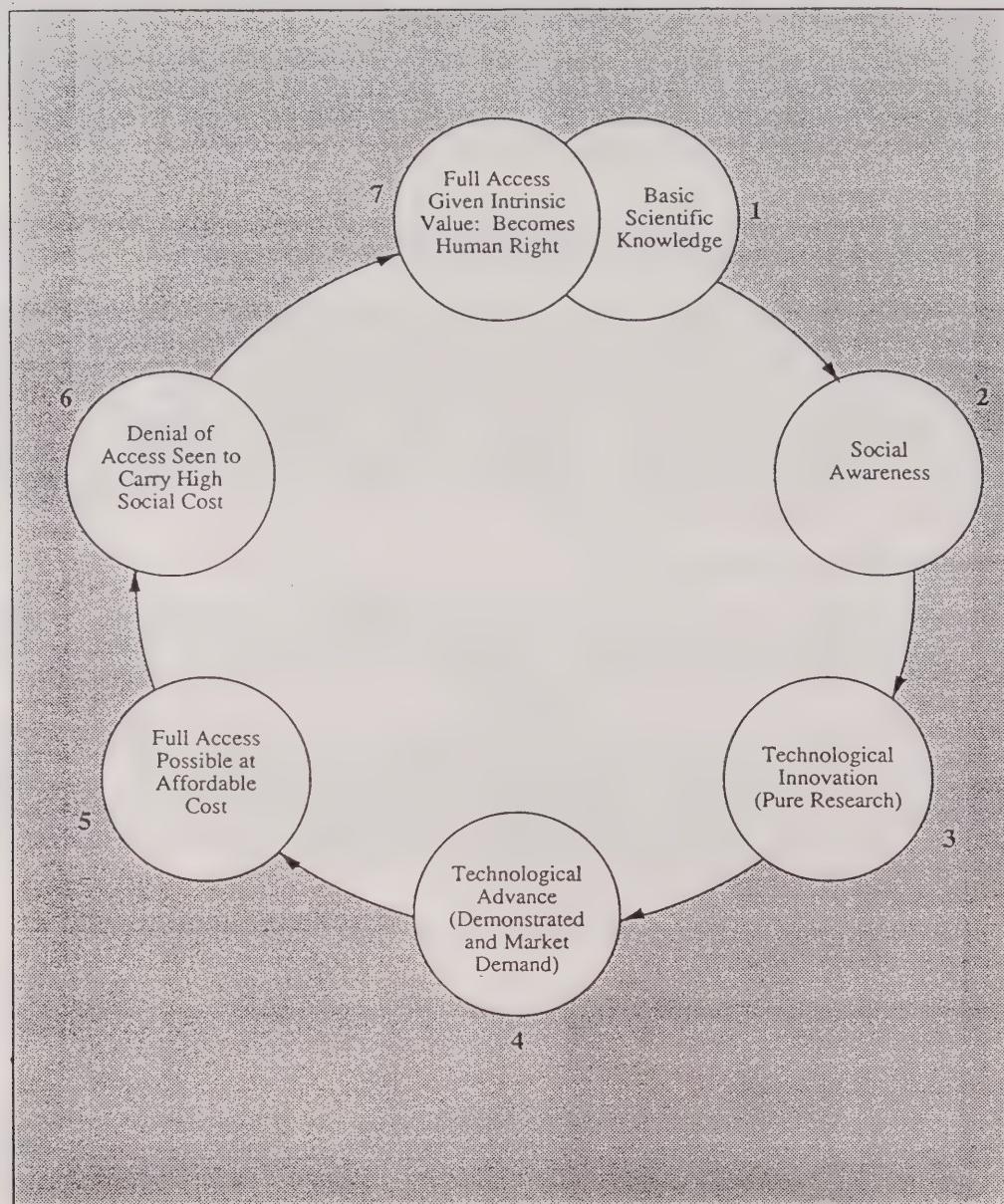
In most developed nations, there are many broadly defined human and civil privileges that occasion a natural badge of justice and intrinsic value. This intrinsic value may be said to confer upon a privilege the status of a "human right" (freedom of speech and religious beliefs, for example).

But there are many aspects of daily life in which privileges are not held to be intrinsic or self-evident but rather evolve and mature over time. In the area of public access in general, and access to passenger transportation for people with disabilities in particular, developed societies can be seen to move through seven distinct phases before access to mainstream facilities and services is afforded intrinsic value and conferred with the status of a basic human right. The seven phases may be classified as follows (see Figure 3):

- o Acquisition of basic scientific knowledge regarding the deleterious effects of restricted access;
- o Emergence of general social awareness of deleterious effects;

¹² See, Hickling Corporation, *International Guidelines for the Determination of Civil and Human Rights for Disabled Persons in the Use of Public Transportation Facilities*, prepared under contract to the Transportation Development Centre (Transport Canada) October 1990 for presentation at an international symposium in Lyon, France, May 1992.

FIGURE 3:
EVOLUTION OF ACCESSIBLE PUBLIC TRANSPORT
AS A HUMAN RIGHT



- o Commencement of technical innovation to broaden access;
- o Advanced rate of technological progress;
- o Evolution of full access at an affordable cost to society;
- o Denial of access seen to carry high opportunity cost to society; and
- o Access awarded with intrinsic value and the status of a human right.

Evidence from a number of countries, including Canada, the United States, Sweden and Britain indicates that basic scientific knowledge of the deleterious psychological effects of barriers to access, though critical as a starting point, is insufficient to confer access to passenger transportation with the status of a "human right." Over time, however, basic knowledge promotes social awareness which in turn stimulates technological innovation. Innovation stems initially from pure, state funded research but leads ultimately to demonstration effects and market demand. Market demand then spurs further technological advance and additional demonstration effects, eventually making the accommodation of disabled persons in mainstream facilities feasible at an affordable (that is, "socially acceptable") resource cost.

As the financial costs of accommodating disability fall toward the threshold of social acceptability (which may be termed, loosely, "affordability") society and policy makers begin to view the denial of access to conventional public transport facilities as a departure from societal norms. Such denial is perceived to carry unacceptable social opportunity cost, both from a socio-psychological and political point of view. This perception unfolds regardless of the state of empirical evidence on the quantitative benefit-cost performance of wheelchair-accessible conventional passenger transportation versus specialized door-to-door service.

Moreover, decisions in a number of countries indicate that the perceived affordability threshold lies above the incremental cost of equipping vehicles with the normal range of special equipment (such as air conditioning). In other words, the costs of modifying conventional passenger transportation for those otherwise unable to use the service need to fall into a socially acceptable range but are still permitted a "premium," doubtless because of the gradually emerging intrinsic value attached to the mainstream accommodation of people with disabilities.

Once the affordability threshold is reached, the provision of fully accessible conventional passenger transport can be seen to mature as a human right. It matures in the sense that access to conventional passenger transportation services occasions intrinsic value rather than being subject to a test of benefit-cost, cost-effectiveness or budgetary impacts. The question of "accessible fixed-route versus specialized service" eventually loses policy significance and the planning focus shifts to the best operational mix of both types of service.

International Evidence

The model outlined above is based upon a detailed analysis of constitutional, judicial, legislative and regulatory history in Canada, the United States, Sweden and Britain.

The evolution of legal protections against discrimination in public facilities in the United States illustrates the catalytic role of basic scientific knowledge in shaping human rights in the area of public access. In 1896, the U.S. Supreme Court ruled that neither common nor constitutional law offered intrinsic protection against the exclusion of a group from entry to a public place. In ruling against a black citizen seeking access to an all-white railway coach, the Court wrote as follows:

"We consider the underlying fallacy of the plaintiff's argument to consist in the assumption that the enforced separation of the two races stamps the coloured race with a badge of inferiority. If this be so, it is not by reason of anything found in the act, but solely because the coloured race chooses to put that construction upon it ... Legislation is powerless to eradicate racial instincts or to abolish distinctions based upon physical difference, and the attempt to do so can only result in accentuating the difficulties of the present situation."¹³

The principle was revisited 58 years later when, in 1954, the U.S. Supreme Court addressed the exclusion of black children from all-white public schools. Chief Justice Earl Warren, writing for the Court, concluded as follows:

"... Does segregation of children in public schools solely on the basis of race, even though the physical facilities and other "tangible" factors may be equal, deprive the children of the minority group of equal educational opportunities? We believe it does ... Segregation of white and coloured children in public schools has a detrimental effect upon the coloured children. The impact is greater when it has the sanction of law; for the policy of separating the races is usually interpreted as denoting the inferiority of the negro group. A sense of inferiority affects the motivation of a child to learn ... Whatever may have been the extent of psychological knowledge at the time of *Plessy v. Ferguson*, this finding is amply supported by modern authority. (Emphasis added) Any language in *Plessy v. Ferguson* contrary to this finding is rejected."¹⁴

What is noteworthy in the present context is that the 1954 decision quoted above did not reject the sanction of separation in the 1896 decision on grounds of intrinsic justice but rather "the extent of (subsequent) psychological knowledge" and the scientific support of "modern authority."

Though necessary to initiate the cycle identified in Figure 3, the emergence of scientific knowledge in itself is not sufficient to bring society to the view that public access has intrinsic value with regard to the transportation of disabled persons. Additional conditions include the state of technological progress and the resource cost implications associated with the integration of technology. For example, citing scientific evidence of the harmful psychological and social impacts of isolation among the disabled population, the United States Congress enacted legislation in the early 1970s granting disabled people broad protection against exclusion from public facilities either built or operated with public funds. Section 504 of the Rehabilitation Act of 1973 states that:

¹³ *Plessy v. Ferguson* 163 U.S. 537, 16 S. Ct. 1138, 41 L. Ed (256) 1896

¹⁴ *Brown v. Board of Education* (First Decision) 347 U.S. 483, 74 S. Ct. 686, 98 L. Ed. (1954)

"No otherwise qualified handicapped individual in the United States shall, solely by reason of his handicap, be excluded from the participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving federal financial assistance."¹⁵

In the early 1980s, Canada followed suit by incorporating disability into the range of groups specifically signalled out in the Canadian Charter of Rights and Freedoms for legal protection from discrimination. Section 15 of the Charter states that:

"Every individual is equal before and under the law and has the right to equal protection and equal benefit of the law without discrimination and, in particular, without discrimination based on race, national or ethnic origin, colour, religion, sex, age or mental or physical disability."

However, in June, 1979 the U.S. Supreme Court, after reviewing a civil suit brought by a deaf student seeking admission to a nursing college, found that Section 504 imposed no duty on the college to modify its program in order to accommodate her disability. In the Davis case, the Court observed that:

"... technological advances could be expected to enhance opportunities for handicapped persons to participate in programs, but without imposing undue financial and administrative burdens ... (emphasis added)"¹⁶

In the same year, a U.S. federal Court of Appeals ruled that Section 504 did not require the adaptation of public buses to ensure access for wheelchairs, arguing that:

"(wheelchair accessible buses) do not require modest expenditures. (They) require extensive modifications of existing systems and impose extremely heavy financial burdens on local transit authorities ... These are the kind of burdensome modifications that the Davis Court held to be beyond the scope of section 504."¹⁷

The role of technology and financial constraints is also evident in Sweden, where regulations written in the late 1970s governing the accommodation of people with disabilities recognize that access is to be provided "as far as possible."¹⁸

¹⁵ Public Law 93-112, 93d Congress, H. R. 8070, September 26, 1973.

¹⁶ Ibid. at 4693.

¹⁷ APTA v. Adams, (U.S. District Court for the District of Columbia, 1979) at 12-13

¹⁸ Swedish Board of Transport, *Regulations for Adapting Public Transport Vehicles for Use by Disabled Persons*, 1989

Similarly, policies of the European Council of Transport Ministers (ECMT) explicitly recognize disabled individuals' inherent freedom of choice but at the same time state that, "member countries should meet the need to design local buses to be as easy as possible for people of reduced mobility to use, although not necessarily to make these accessible to people in wheelchairs."¹⁹

Over the course of the 1970s and 1980s, however, social awareness and political pressure -- the latter due in large measure to the efforts of disabled people and their advocates -- led governments in Canada, Sweden, Britain and the United States to finance research and development of technologies to make conventional passenger transportation accessible to ambulant and, significantly, to non-ambulatory persons. Canada, through the work of the Transportation Development Centre, is widely considered the world leader in the research and development effort.

Innovation in the form of terminal and vehicle-based hydraulic lifts, low-floor and platform-level vehicle concepts, passenger information systems, accessible railway operating systems and procedures and aircraft boarding devices for wheelchairs were eventually demonstrated in passenger operation, experimentally at first and later through their staged introduction by a limited number of cities into active service. A market thus evolved and competition among private manufacturers led to rapid improvement in the reliability and cost-characteristics of boarding technology for wheelchair users and other non-ambulatory people.

From Basic Knowledge to Human Rights: Steps in Transition

By the end of the 1980s, the costs of equipping conventional passenger transportation for wheelchairs, though high in relation to the cost of specialized service alternatives, is no longer universally perceived to impose undue financial burdens on transportation authorities. Perceptions are shifting in part from the efforts of private manufacturers to improve the maintenance characteristics of boarding equipment; from demonstration effects among transit operators themselves, most notably from trials in Seattle, Washington in the United States and Boras in Sweden, where experiments and active operations proved financially feasible; and from economies of scale in manufacturing the equipment as the market for it expands.

With the advent of progressively more reliable and affordable technology to affect the modification of passenger transportation facilities, and with powerful political forces pressing for a policy of full access, the United States can be seen to have moved through the sixth phase of the cycle in Figure 3; full access to conventional passenger transportation facilities in that nation now occasions intrinsic value and can be said to carry the status of a human right. In July, 1990 the Congress of the United States enacted the Americans with Disabilities Act (ADA), declaring as its purpose, "to provide a clear and comprehensive national mandate for the elimination of discrimination against individuals with disabilities."²⁰ In the area of transportation, the ADA requires that all public transport vehicles

¹⁹ E.A. Frye and M.J. Heraty, *Transport Provision for Disabled People in Europe: A Review of Developments, Trends and New Initiatives*, Proceedings of the Fourth International Conference on Mobility and Transport for Elderly and Disabled Persons, July 21-23, 1986, p.41.

²⁰ Public Law 101-336, July 26, 1990 Americans with Disabilities Act of 1990.

purchased after the date of enactment must be accessible to people with disabilities, including those who use wheelchairs and that all stations, terminals and other facilities and buildings must also be made accessible within a stated timeframe (of up to 30 years).

It is noteworthy that benefit-cost and cost-effectiveness analysis in the United States continues to favour specialized door-to-door transportation. The fact that the Congress chose to require, as a matter of law, the equipage of all conventional public transport for people with disabilities is thus evidence that access has been conveyed with intrinsic value and, in this sense, with the status of a human right. In radical contrast to earlier attempts to breath the status of human rights into the accessibility of public transport vehicles, the transit industry itself has not objected to the Congressional action on the basis of cost. As well, while public opinion had been negative in prior moves to enforce full access, the press and other media are now supportive.²¹ This indicates that although the costs of adherence are high (the federal Department of Transportation estimates \$15 billion in implementation costs over 30 years) Congressional passage of the Americans with Disabilities Act has occurred beyond the "affordability" threshold, thereby ensuring broad public endorsement even in the absence of a supportive cost-benefit or cost-effectiveness test.

Though less extreme, other nations too can be seen to be moving gradually into the sixth phase of Figure 3. The Swedish Parliament has now acted to promote the full accessibility of conventional public transport for wheelchair users. In Britain, a number of localities have chosen to implement partially accessible conventional public transport systems, indicating that public sentiment in these nations is moving through phases four and five in Figure 3.

Evidence indicates that Canada is also moving gradually toward the acceptance of full access as an intrinsically worthwhile policy. A series of 1983 amendments to the Canadian Human Rights Act authorize the Governor-in-Council to prescribe accessibility standards for goods, services, facilities and accommodations. Enacted in 1988²², amendments to the National Transportation Act provide mechanisms for the National Transportation Agency to develop and implement federal regulations

²¹ In 1979, following initial federal efforts to enforce full accessibility, the generally liberal New York Times published the following editorial remarks;

"Do the 30 million Americans afflicted with physical or mental handicaps have a right of access, no matter what the cost, to all publicly sponsored activities? Objections are too easily misunderstood. Integrating the handicapped into everyday life is a valuable social goal. Vast numbers of them are on welfare when they could be doing productive work -- if the barriers to their mobility and opportunity were lowered. The nation is belatedly moving in the right direction. For reasons of humanity and sound social policy it should move faster still. But that hardly justifies making every bus kneel to pick up a few new passengers. The handicapped have a right to respect and reasonable assistance, not to an unlimited claim on public funds in the name of a dubious principle (emphasis added). (New York Times, Sunday, November 18, 1979).

²² Bill C-131 Amendments to the National Transportation Act

accessibility for all modes under its jurisdiction. To date, however, no regulations or standards have been issued, in large part because of the absence of clear policy guidance from the federal government (with the exception of Via Rail services -- see below).

There are, however, "natural forces" -- ie, those outlined in Figure 3 -- emerging in Canada that indicate increasing acceptance of the human rights factor as a real and unavoidable aspect of the policy making process. At the local level, Vancouver's decisions to equip all components of the new light-rail system for wheelchair access, in spite of the more favourable cost-effectiveness characteristics of a specialized door-to-door approach, indicates that the intrinsic value of accessibility itself was seen to outweigh cost-effectiveness considerations in the decision process. The Vancouver decision actually cites the principle of "human rights" per se, indicating that full access carries inherent and intrinsic value in view of the public at-large. The Toronto Transit Commission (TTC) has also made a policy decision to improve all transit vehicles and facilities for disabled persons who can only use them with difficulty. The TTC has also decided to make certain "key" subway stations accessible to wheelchair users and other non-ambulatory persons even though its own evidence indicates that specialized service is likely to require smaller budgetary outlays. (The TTC will also continue to provide specialized, door-to-door transportation).

At the federal level, it is government policy that VIA Rail be fully accessible to all transportation-disabled persons. This policy stemmed from the 1980 "Clariss Kelly decision" of the (then) Canadian Transport Commission. Kelly was a law student in a wheelchair who sought to travel from her home to school and back by train. VIA Rail had refused to assist her to board and required that she be accompanied at all times by an attendant (who was charged an additional fare). Acting under the general authority of the National Transportation Act of 1967, the Commission granted Kelly (and disabled people as a class) access to rail transportation, arguing that;

"Miss Kelly in our view has much to offer society and we will lose in the long run by allowing barriers, either financial or otherwise, to be placed in her way when she travels"²³

Beyond Via Rail, however, the federal government has not taken prescriptive policy steps with regard to other modes under its jurisdiction, namely the intercity bus industry, commuter rail systems, airports or ferry services. To be sure, the Transportation Development Centre has developed and tested wheelchair boarding devices for intercity buses and has made extensive studies of the cost, technical feasibility and comparative economic performance of making commuter rail systems accessible to all transportation-disabled persons. The question of airport access has also been subject to serious study at the federal level. While these studies indicate a strong interest in the role of passenger transportation in promoting a better life for people with disabilities, there has yet to emerge a clear federal policy as a basis for regulation or standards.

A Framework for Incorporating the Question of Human Rights into the Consideration of Passenger Transportation Policy

Because of the emergence of full access to conventional passenger transportation as a technically viable option, and the growing social awareness of public access for the disabled as an objective with

²³ Clariss Kelly v. VIA Rail Canada (1980) 1 CHRR D/97 at 107/8.

recognized intrinsic value, decision-makers cannot rely solely upon the normal techniques of benefit-cost and cost-effectiveness analysis for policy guidance.

As a complement to benefit-cost and cost-effectiveness analysis, a framework of criteria is required against which decision makers can establish whether full access to all or part of a passenger transportation system carries *intrinsic value*. If the criteria are judged to be met,²⁴ the actual extent to which the system is made fully accessible can then be regarded as a planning issue, to be decided on the basis of cost-effectiveness and related analysis. If, on the other hand, the criteria are not met, passenger transportation choices would be made using normal economic decision criteria.

A framework of four criteria is presented in Figure 4. An affirmation of each of the four criteria would signal that full access (to at least a portion of the system in question) has intrinsic value and should thus have a role in passenger transportation policy. In view of the dynamic and changing technological and operational environment, the policy making process may thus be seen as one of continuously monitoring the criteria with respect to each mode of transportation under federal jurisdiction -- rejection now could change to affirmation later on as the technical and economic conditions change. Economic and technical studies, surveys, public hearings, conventional wisdom among decision makers and even referenda represent valid monitoring and policy making techniques.

FIGURE 4:
**FRAMEWORK OF NECESSARY CONDITIONS FOR FULL
ACCESSIBILITY AS A HUMAN RIGHT**

1. There is a widely held scientific belief that lack of full access has deleterious psychological effects for people with disabilities.
2. Technology is available that, at affordable budgetary expenditures, would make a passenger transport system either in whole or in part fully accessible to people with disabilities.
3. The denial of full access to all or part of a public transport system can be held to represent a departure from modern design norms, taking into account the availability of new, though proven technology.
4. The denial of full access to all or part of a public transport system is presumed by a broad cross-section of society, including the relevant scientific community, to impose intangible and tangible opportunity costs that are likely to exceed the direct costs of providing access.

²⁴ A situation that could be characterized as confirming a human right.

CHAPTER 4 A REVIEW OF THE EVIDENCE

While the first criterion established in Figure 4 can be examined without regard to specified modes of passenger transportation, the remaining three are chiefly mode-specific. Thus following a brief examination of the first criterion, this Chapter addresses each of the major passenger transportation modes in turn, asking how each sizes up at present and, looking ahead, how each might develop under alternative federal policy directions.

IS THERE A WIDELY HELD SCIENTIFIC BELIEF THAT LACK OF FULL ACCESS HAS DELETERIOUS PSYCHOLOGICAL EFFECTS ON PEOPLE WITH DISABILITIES?

There is now a widely held scientific belief that failure to integrate disabled people into the mainstream of daily living is damaging to the physical health and socialization of people with disabilities. Educators and sociologists, notably Dr. Francis Carp -- a highly respected social psychologist -- have used valid statistical and psycho-analytic techniques to document higher rates of discouragement, low self-esteem, educational under-achievement and inadequate social skills among disabled people separated from the mainstream as compared to those whose lives have been integrated into mainstream institutions.

What remains less certain, however, is whether separate transportation services *per se* cause social harm to disabled people. Systematic sociological and psychological research has not been conducted specifically with regard to transportation. Traditionally, transportation has been regarded as a "derived" demand, a means of gaining access to life activities rather than an end in itself. Inasmuch as specialized transportation services tend to attract more demand than accessible fixed route systems (which is often the case -- see below) they foster a greater amount of integration with regard to the activities at the destinations they serve. In this sense, some analysts argue that for policy purposes passenger transportation should not be regarded as a "mainstream institution" since doing so could have the paradoxical effect of limiting the number of disabled people who can reach jobs, shops, friends and places of entertainment, doctors' offices and other "bone fide" life activities.

On the other hand, many people with disabilities, and their advocates, have testified before human rights commissions, legislative hearings and judicial proceedings claiming that without the same freedom to choose as that available to the public at-large, the disabled can never see themselves as equal members of society. Those in support of this argument suggest that while there will always exist a segment of the disabled population who need specialized transportation assistance, most who require public transportation will use conventional modified so as to permit them to do so.

In conclusion, while scientific evidence in support of the need to integrate disabled people into mainstream society is conclusive, the case with regard to conventional modes of passenger transportation remains unclear. There is, however, broad anecdotal support for the belief that failure to offer the choice itself has detrimental, if intangible, effects.

IS TECHNOLOGY AVAILABLE THAT, AT AFFORDABLE BUDGETARY EXPENDITURES, WOULD MAKE A PASSENGER TRANSPORTATION SYSTEM EITHER IN WHOLE OR IN PART ACCESSIBLE TO PEOPLE WITH DISABILITIES?

Although federal jurisdiction extends to inter-provincial passenger transportation, policy decisions will inevitably be influenced by developments in all modes of passenger transportation. This review touches on each of the principal systems.

Technology has evolved to serve the two distinct market segments discussed in Chapter 2, (i) those who can use passenger transportation systems only with difficulty and (ii) those unable to use the system due to physical or cognitive barriers.

Persons Able to Use Conventional Passenger Transportation Systems with Difficulty

Technological developments have progressed substantially in easing the problems of elderly and moderately disabled persons in their use of conventional passenger transportation systems. Reduced step heights for those with arthritic and functionally-related impairments; non-slip flooring; more and better hand-holds and stanchions; ticketing technologies that accommodate agility and dexterity impairments; special strips for the blind and teletypes for the hearing impaired; and training for personnel in the needs of mentally disabled people are all being adopted by a wide range of passenger modes. The Toronto Transit Commission, for example, recently adopted a policy of equipping all buses, streetcars, subway cars and stations with facilities to make its passenger transportation facilities more effective for users with disabilities.²⁵

There is no doubt that steps to make conventional passenger transportation systems more effective for disabled people in this market segment is substantially less costly and more cost-effective than providing them with specialized transportation service. Virtually all studies have determined that with measures in place to improve conventional transit for this group, they can be excluded from eligibility for specialized service (if provided), thus radically reducing total expenditures.²⁶

Persons Unable to Use Conventional Passenger Transportation Systems

This section summarizes the most recent findings and experience in each of the major passenger transportation systems with regard to the accommodation of transportation-disabled persons who are physically or mentally unable to use them as conventionally designed.

Urban Bus Systems. The chief technological requirement here is a means for wheelchair users to get on and off buses. The principal technology is the hydraulic retractable lift, mounted at either the front or centre door. First tested in the early 1970s with poor results (mainly in the form of a high rate of breakdowns), lifts today are moderately reliable and used in revenue service in many

²⁵ Toronto Transit Commission, *Choices for the Future*, August 1989

²⁶ Hickling Corporation, *Department of Transportation: 49 CFR Part 27, Non-Discrimination on the Basis of Handicap in Federally-Assisted Programs; Proposed Rule (Regulatory Analysis)*, July 4, 1990

U.S. cities. The low-floor bus with boarding ramps is an emerging technology with great promise. It offers a much simpler technology; maintenance costs are thus lower although, currently, low-floor vehicles are substantially more costly in terms of capital outlays. Canada offers the most advanced product line here.

The cost and cost-effectiveness of modifying urban bus system for wheelchair users and others who cannot use steps has been analyzed extensively using the framework presented in Figure 1 (Chapter 3). The most recent analysis, conducted on behalf of the Toronto Transit Commission, finds that projected costs are higher than those incurred in the provision of existing specialized transportation services in Toronto over the entire range of possible demand. Achievement of the breakeven demand level is found to be highly unlikely, even under an assumed level of disabled ridership that lies well above that achieved by the most successful systems in the United States.

Results for three options (key bus routes lift-equipped; half the bus routes lift-equipped; and all bus routes lift-equipped) are compared with specialized service costs in Figure 5. As the Figure shows, even with demand for lift-equipped buses at the highest assumed level (for which the Figure shows less than a 10 percent probability of achieving) the cost-per-trip of specialized service remains beneath that of an accessible bus system. The specialized service is also projected to yield five-times more total trips, thus resulting in a greater overall level of mobility.

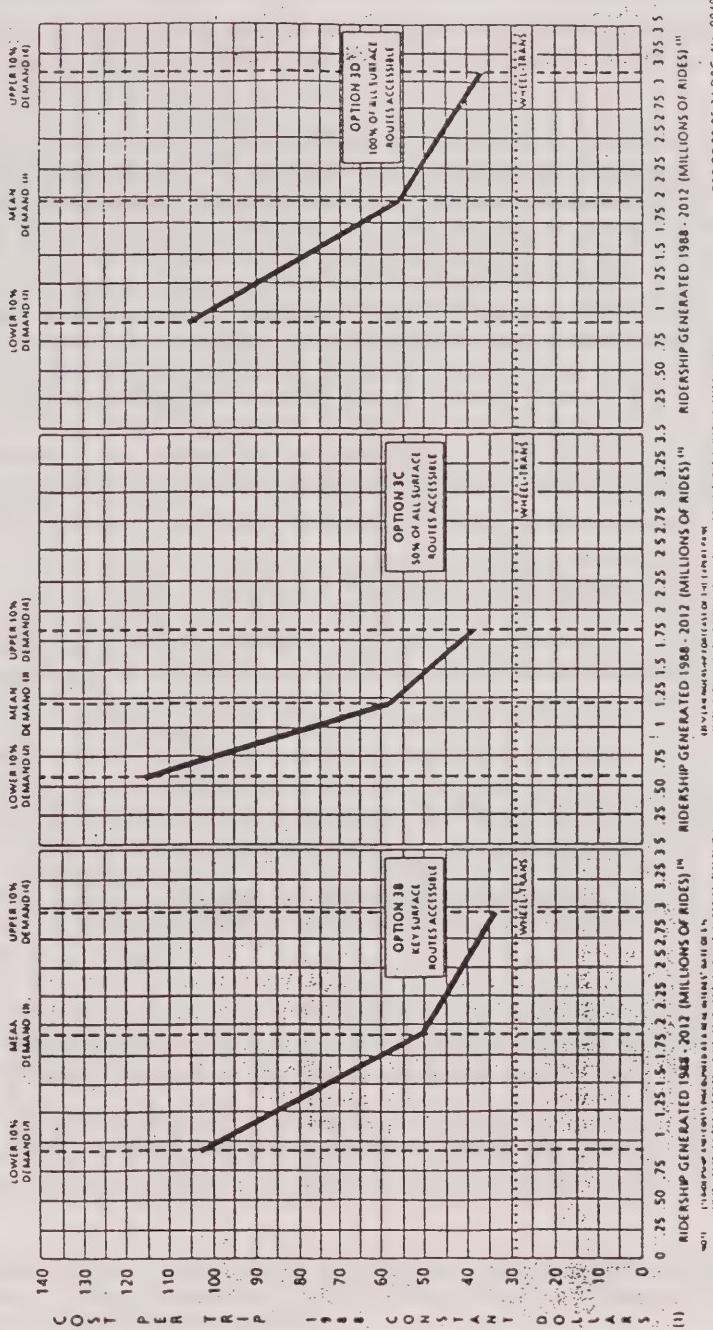
It is interesting to note, however, that at the higher (lower probability) assumed levels of demand, cost-per-trip of accessible buses and specialized service begins to converge. The TTC has decided against the lift-equipage of regular route buses but continues to watch the market for evidence of change in current economic conclusions. This is most likely to occur with wide-spread availability of low-floor vehicles, now foreseen toward the end of the 1990s.

Urban Subway and Light Rail Systems. Proven design and technology is available to make newly constructed subway and light rail systems fully accessible; subway systems in Washington DC, Atlanta, Georgia, San Francisco; and light rail systems in Miami and Vancouver have proven technologically reliable. Technology to retrofit existing systems to make them accessible is also available though far more costly.

The Toronto Transit Commission has examined the comparative costs of making key subway stations accessible along with the provision of specialized transportation and a limited number of accessible bus routes to feed and distribute disabled people to and from the subway system. The results for two options are displayed in Figure 6. The analysis indicates that the breakeven demand (in comparison with specialized service exclusively) occurs in the feasible range, albeit below the most likely outcome in the light of empirical evidence of demand in U.S. cities. As a result of these findings, the TTC has decided to implement the key station-feeder policy over a period of 20 years, modifying the stations as they come due for major rehabilitation.

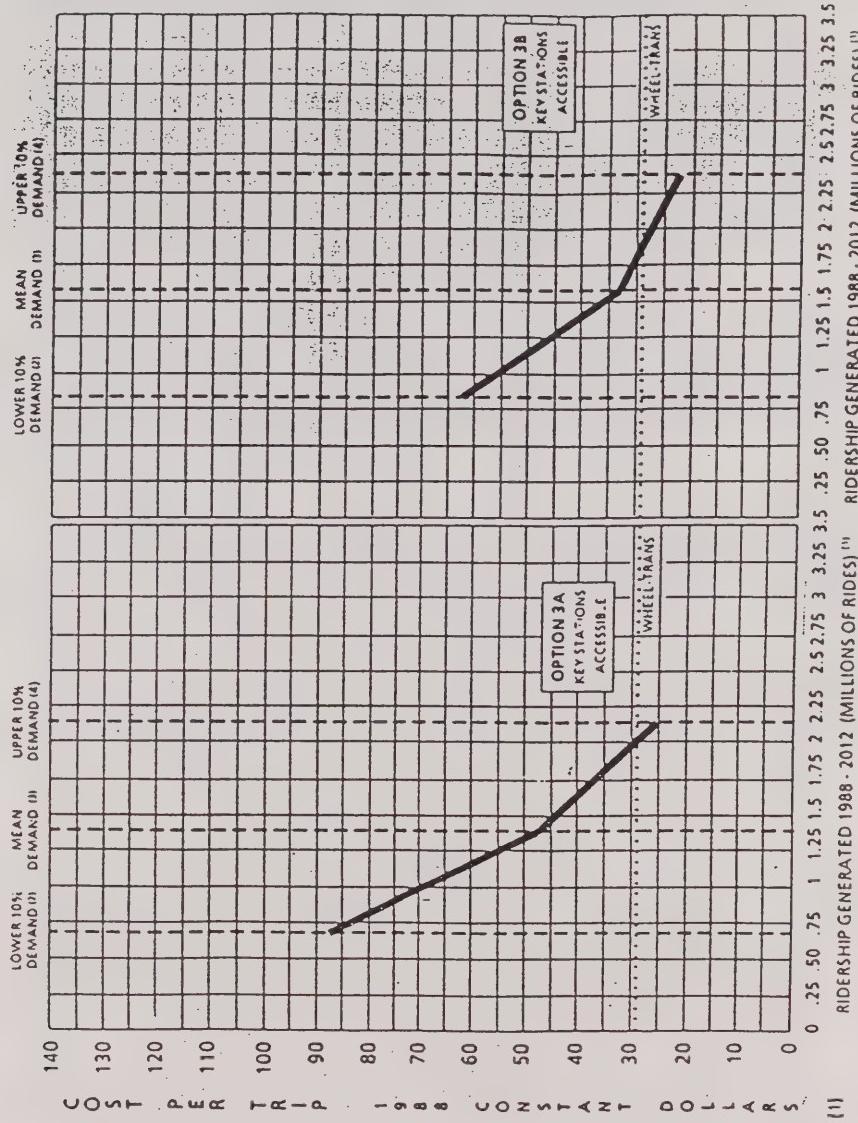
Commuter Rail Systems. In addition to the design and technological requirements to make commuter rail systems accessible to wheelchair uses and others with severe functional disabilities, the modification of commuter rail systems must consider the question of logistical feasibility. Some systems operate peak schedules with as little as 90 second headways. Since the boarding time for wheelchairs is three minutes or more, during which time other passengers may be unable to board, a high level of demand can, theoretically, result in severe schedule disruption. Moreover, some

FIGURE 5:
COMPARISON OF COST PER TRIP
KEY TORONTO BUS ROUTES ACCESSIBLE VERSUS SPECIALIZED SERVICE (WHEELTRANS)



Practice in Disability and Aging
HICKLING

FIGURE 6:
COMPARISON OF COST PER TRIP
KEY STATIONS ACCESSIBLE VERSUS WHEEL-TRANS



SOURCE: Hickling Corporation analysis for the Toronto Transit Commission

systems operate during limited periods of time when freight train operations cease. Commuter rail contracts must adhere to these "windows" and thus may be unable to add trains in order to compensate for lost schedule time.²⁷

Figures 7 and 8 summarize results of economic and logistical feasibility studies conducted for the Lakeshore West Line, Toronto (The GO system) and the Rigaud Line, Montreal. In the range of most likely demand for accessible commuter rail service on the Lakeshore West Line, specialized service is estimated to be less costly than accessible commuter rail service. This was found to be the case where specialized service was assumed to feed and distribute passengers to and from the rail system and, as well, where specialized service was not assumed to operate. If higher levels of demand are assumed, costs begin to converge, but schedule delays are estimated to increase to the point of maximum operationally sustainable delay (unless only end stations are made accessible -- see Figure 7). In the case of this system, the study concluded that accessibility was not only the more costly alternative, but potentially infeasible from a logistical standpoint.

The situation was found to be less severe, both economically and operationally in the case of the Rigaud line. Specialized service was still found to offer the lower cost service and serve more disabled travel demands, however (Figure 8).

Intercity Bus Systems. Design and technology to make intercity bus service accessible to those unable to use steps is still under development. Prototype vehicle-based lifts have been tested in revenue service in Newfoundland (with very little take-up by people with disabilities) and other concepts, such as station-based lifts, have been studied conceptually by Transport Canada. Under the Americans with Disabilities Act, the intercity bus industry has been exempted from accessibility requirements pending the outcome of a Congressional study (being conducted by the Office of Technology Assessment) of the technological alternatives.

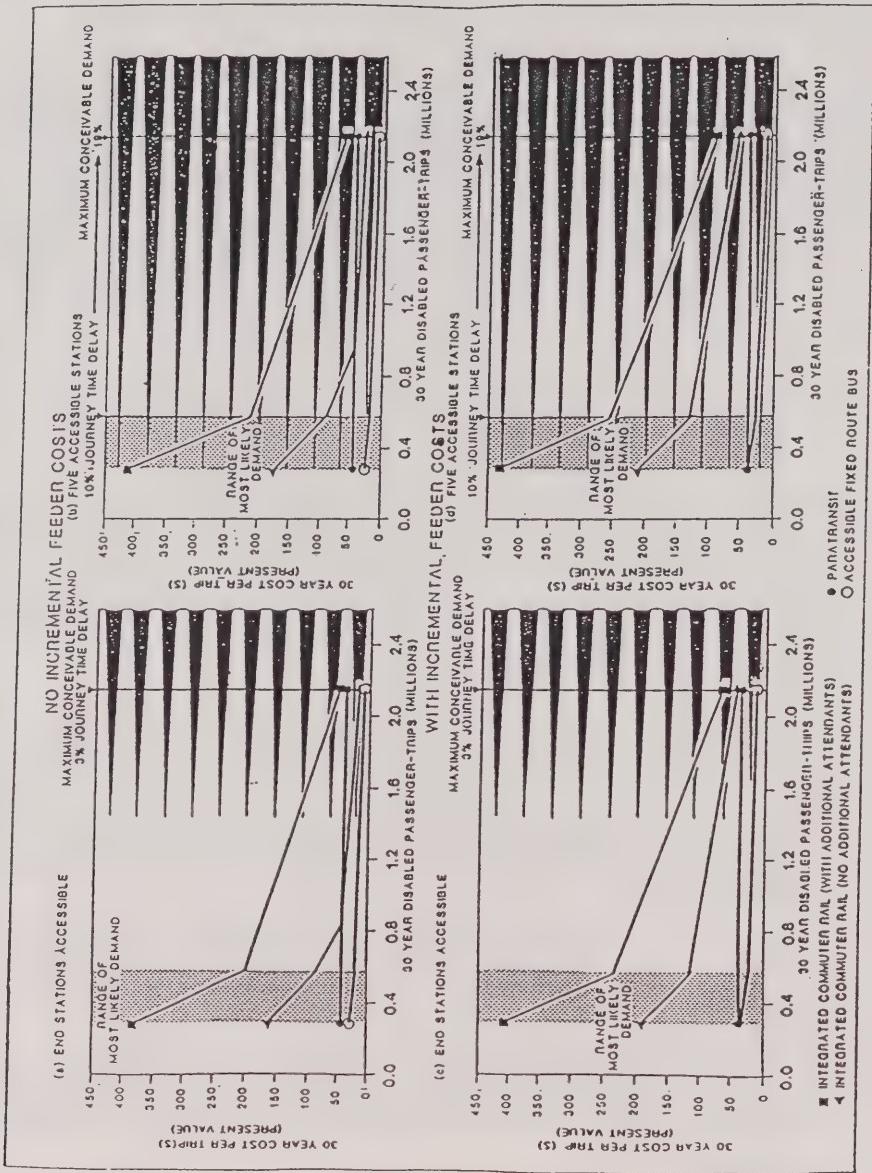
Research studies of the comparative economics of accessible intercity bus service versus specialized service over comparative distances have been conducted by Transport Canada. Results, summarized in Figure 9, indicate that specialized service is likely to cost substantially more while potentially serving marginally more persons. While economic analysis thus favours accessible over specialized service, further technological developments are still required. In addition, the intercity bus industry has consistently argued that any federal requirement to equip vehicles for wheelchairs must be accompanied by financial assistance.

Intercity Rail Systems. Via Rail uses a mechanical, station-based lifting technology to enable wheelchairs to get on and off trains. To date, no schedule disruption has been experienced with this equipment in revenue service.

Aviation Systems. Studies of airport accessibility have singled out long travelling distances through terminals and information and media-related problems of speech and hearing impaired persons as the most pressing technological issues. The Transportation Development Centre has prototyped and

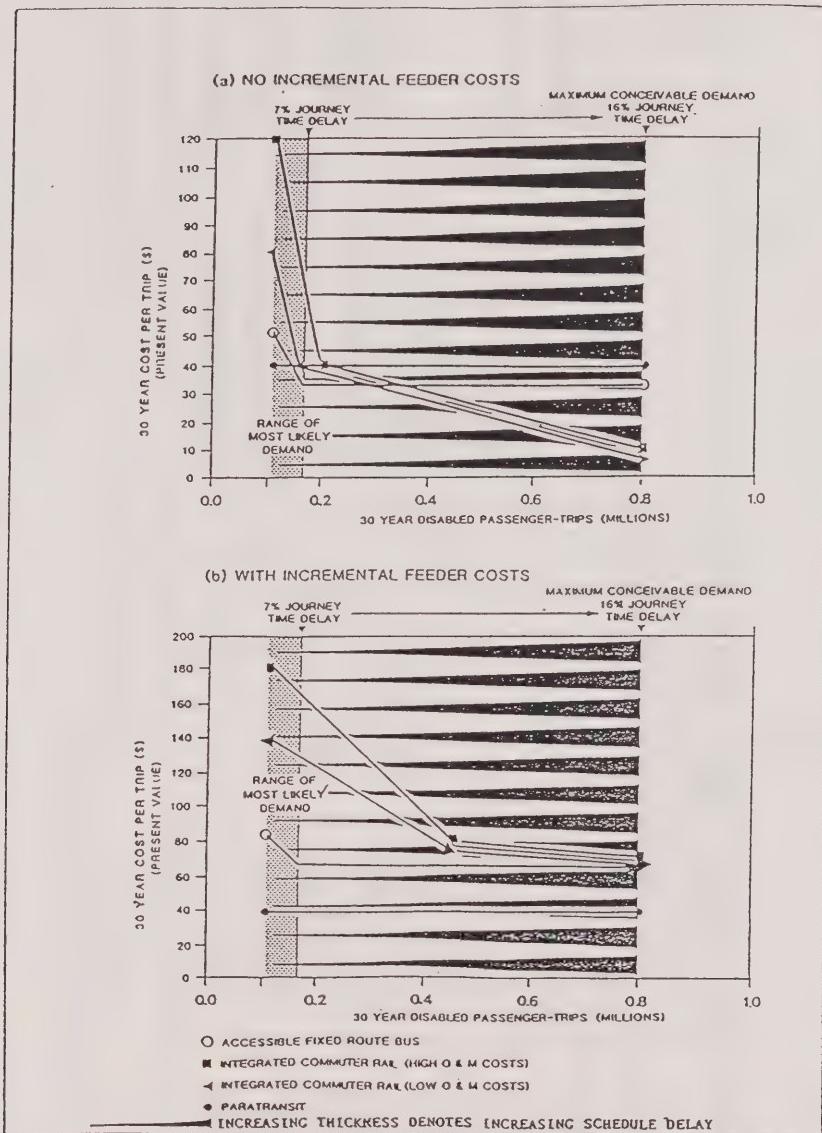
²⁷ For a detailed analysis of these issues see, Hickling Corp. **Accessible Commuter Rail for the Disabled: An Evaluation and Decision Making Framework**, Transportation Development Centre, September 1986.

FIGURE 7:
COST PER TRIP OVER 30 YEARS,
LAKESHORE WEST LINE: TORONTO



SOURCE: Hickling Corporation, for the Transportation Development Centre

FIGURE 8:
COST PER TRIP OVER 30 YEARS,
RIGAUD LINE, MONTREAL
(Four Stations)



SOURCE: Hickling Corporation, for the Transportation Development Centre

FIGURE 9:
COMPARISON OF OPTIONS

OPTION	ROUTE TYPE	ANNUAL COST PER ROUTE*	WEEKLY TRIPS PER ROUTE	UNIT COST (PER TRIP)**	EQUIV. BUS TRIP COST**	INTANGIBLE COSTS		INTANGIBLE BENEFITS	
						trips/week	\$/trip	\$/trip	
1. Lth Equipped Bus	Short Haul	\$13 - 40k	7 - 53	\$27 - 46	\$25	<ul style="list-style-type: none"> - Advance reservations required. - Terminals, washrooms should be made accessible. 		<ul style="list-style-type: none"> - Integrated into mainstream transportation system. - could aid general public; those with babies, temporary disabilities, etc. 	
	Long Haul	\$10 - 48k	3 - 26	\$67 - 94	\$41				
2. Station-Based Lift	Short Haul	\$13 - 56k	7 - 59	\$33 - 51	\$25	<ul style="list-style-type: none"> • poor quality of service; can be physically and mentally uncomfortable (travelers must transfer several times, and use exit seats for long period). - advanced reservations required. - further technical development required. - terminals, washrooms should be made accessible. 		<ul style="list-style-type: none"> - beyond mandate of bus operators. - advance reservations required. - not integrated into mainstream transportation system. 	
	Long Haul	\$18 - 50k	3 - 26	\$58 - 158	\$41				
3. Parallel Service	Short Haul	\$43 - 89k	8 - 69	\$44 - 131	\$25	<ul style="list-style-type: none"> - beyond mandate of bus operators. - advance reservations required. - not integrated into mainstream transportation system. 		<ul style="list-style-type: none"> - excellent level of service. - advance reservations required. - provider can control uptake (and costs) via eligibility 	
	Long Haul	\$65 - 156k	4 - 30	\$136 - 394	\$41				
4. Subsidy Scheme	Short Haul	\$8 - 132k	7 - 123	\$39	\$25	<ul style="list-style-type: none"> • does not provide service (most intercity modes are relatively inaccessible at present). - beyond mandate of bus operator. - must be rationalized with other social programs. 		<ul style="list-style-type: none"> - provider can control costs via eligibility policies. - potentially greater range of choice amongst beneficiaries. 	
	Long Haul	\$10 - 170k	3 - 53	\$126	\$41				

* Based on additional (excluding the costs to the users), present - valued over 30 years, averaged amongst the representative long or short haul routes.

** Includes all costs, including fares and transfers.

developed a wheelchair transport for terminal operations and an information processing unit aimed at elderly, visually, hearing and speech-impaired persons and wheelchair users. The federal government has yet to require steps to accommodate disabled persons at Canadian airports and these technologies are thus not in use (other than at test sites).

CHAPTER 5 ALTERNATIVE FEDERAL POLICY DIRECTIONS

This Chapter outlines current federal policy with regard to disability and passenger transportation and presents a summary-evaluation of alternative policy directions.

CURRENT FEDERAL POLICY

Although the federal government is authorized to set standards and regulate inter-provincial passenger transportation operations with regard to disabled persons, no standards or regulations have been developed under current policy. Existing government practice emphasizes research and development, with hoped-for demonstration effects in the marketplace, and efforts to persuade private and crown operators to adopt accessible technologies, operations and practices. Current federal practice relies upon disabled individuals to bring claims against passenger transportation systems under the Human Rights Act and the Canadian Charter of Human Rights.

Today, passenger transportation services under federal jurisdiction are largely inaccessible. Substitute specialized services are for the most part not available. Steps to improve systems for those who use them with difficulty are scarce. All this is due in part to the absence of proven technology. But for the most part, it represents resistance on the part of operators to absorb the additional costs and liability of carrying people with disabilities and a reluctance on the part of the government to subsidize their efforts. Research and development, demonstration effects and persuasion have thus far failed to bring about an accessible passenger transportation environment. Other than the Kelly case of 1980, disabled persons have not acted as a class to affect the accessibility of passenger transportation through suit against modal systems. A key reason might be lack of information about the technical options and thus insight into what can reasonably be claimed.

ALTERNATIVE POLICY DIRECTIONS

Four broad courses of action are open to the federal government over the 1990s and beyond, as follows:

- o Continue Current Policy;
- o Develop and Publish Prescriptive Regulations (akin to the Americans with Disabilities Act);
- o Develop and Publish Non-Prescriptive Performance and Engineering Standards and Guidelines for each Modal Area; and
- o Develop Special Initiatives At the Federal Level.

Continue Current Policy

The long-term continuation of current federal practices appears unlikely to bring about significant change in the accessibility of the passenger transportation systems under federal jurisdiction. The current approach has been in place for over a decade, during which time a great deal of technological progress has been made and important and practical insights into the travel needs of people with disabilities has been achieved. Many of these advances have been spear-headed in Canada (by the Transportation Development Centre and Transport Canada). Under current policy, however, these advances have not been integrated into passenger transportation operations.

Prescriptive Regulations

As in the case of the Americans with Disabilities Act, under this approach the National Transportation Agency would publish detailed regulations stipulating the requirements of each mode under federal jurisdiction and a timetable for their achievement. While the Human Rights Commission would still retain the right to hear complaints, including complaints against the regulations themselves, careful consultation in the regulatory process would minimize future conflicts.

Unlike the ADA, regulations could be largely "performance" based, indicating the required outcome of modal efforts but without stipulating precisely how they would have to be achieved. The research, development and demonstration programs would continue in order to "serve and catalyze" innovation.

As shown in the previous Chapter, passenger transportation costs would rise under this approach. Federal administrative law prohibits the government from imposing "undue financial burdens"²⁸ upon regulated bodies. In the Province of Ontario, an "undue burden fund" has been established from which regulated systems can draw if they make a successful claim to the Province. Such a fund would possibly be necessary at the federal level under the regulation option; without one, the federal government could incur costly and lengthy civil litigation.

The principal policy rationale for prescriptive regulations is one which views transportation as a "merit good," a minimum level of which is judged to be required by all, regardless of ability to pay or physical or mental ability. The non-regulatory approach under current policy is not satisfying the merit good criterion. The Human Rights rationale would enter into the technical approach to the regulations themselves -- whether full access would be required where specialized service could be delivered at less cost.

The principal advantage of prescriptive regulation would be their clarity regarding the federal position. This clarity would serve not only to guide transport operators but the entire research and development effort as well. At present, it must be said that the Transportation Development Centre and the disabled programs office of Transport Canada are forced to set their own agenda and, to "steer policy from behind" rather than the more traditional Cabinet-directed approach to socially sensitive issues.

²⁸ The prohibition against undue financial burden stems from principles of common law. See also the federal government's Regulatory Analysis Review Process. (**The Federal Regulatory Process**, Communications Directorate; Office of Privatization and Regulatory Affairs, January, 1988.)

The key disadvantage of prescriptive regulation is the high cost it would inevitably impose upon the passenger transportation system and, through undue burden subsidies, on the federal deficit. This, of course, could be controlled by spreading it over as many as 50 years or more through the regulatory timetable. Realistically, however, meaningful regulations would undoubtedly impose high financial costs.²⁹

Non-Prescriptive Guidelines and Voluntary Standards

This approach would represent a middle-ground between current policy and prescriptive regulations. In setting out voluntary technical standards and guidelines, the federal government could establish a clear message regarding its view of the roles and responsibilities of passenger transportation systems with regard to people with disabilities. Guidelines and voluntary standards would also provide information to disabled persons about what is and what is not feasible.

The principal policy rationale for this approach would state that Human Rights Commissions have the job of interpreting the responsibilities of passenger transportation systems under the Canadian Charter of Human Rights and the Human Rights Act (as amended). The government's role is to provide technical information to providers and consumers. Disabled consumers can then elect whether or not to bring disputes against passenger transportation operators before the Human Rights Commission.

An advantage of this approach is that the guidelines and standards could change quickly in relation to scientific and technological advance. As well, it does not carry as high an immediate or direct cost implication as an approach based upon prescriptive regulation (although, as at present, subsidies would need to be available to bone fide disabled groups to fund litigatory action).

A disadvantage of this approach is that it places the onus upon the disabled community to take the first step in enforcement proceedings. As an inherently less mobile, less well educated, poorer and, in the case of mentally disabled people, less articulate and informed group, this could be seen as putting the target group at a social disadvantage. Another disadvantage is that the federal government would have no control over the decisions of Human Rights Commissions; they could, for example, accelerate implementation schedules decades earlier than the federal government might be inclined to do in regulations. Costs to industry and the federal government could thus actually be higher under this approach.

Special Initiatives

From time to time the federal government will identify gaps in mobility that it can help resolve through special initiatives. A major gap at present is the lack of recognition of the private automobile as an instrument of policy. For most disabled people, like other members of the general public, the automobile represents the most effective means of mobility. Yet low income and the high cost of vehicle adaptations makes automobiles inaccessible.

²⁹ Preliminary Regulatory Impact Analysis conducted by the Hickling Corporation for the U.S. Department of Transportation finds that the ADA will cost over \$15.0 billion (in present value, over 30 years).

In Britain, a program called "Motobility" makes subsidized interest car loans available to eligible disabled persons, a monthly cash "mobility allowance", paid to all eligible disabled persons, can be applied to defray the loan. In the United States, the Veterans Administration offers a lump-sum subsidy to disabled war veterans towards the purchase of an automobile. This subsidy covers about one-half the cost of the vehicle and is available once only. Similar options are only now beginning to be explored in Canada.

RECOMMENDATION

The Royal Commission will need to advise the government on an appropriate course for the next 30 to 50 years in all aspects of passenger transportation, including the role of each mode with respect to people with disabilities. The Commission should examine the options outlined above in the context of the many other issues under its consideration. The principal claim of the disabled is that, like everyone else, they are members of the general public. The Royal Commission will be balancing many conflicting objectives in seeking to maximize the general public welfare. Those with disabilities have a right to -- and expect -- equal treatment and due process, not an unlimited claim on public resources.

It should also be understood that the sweeping Americans with Disabilities Act followed 20 years of intense political and judicial struggle by disabled people to establish the principle of non-discrimination in every aspect of daily life, including transportation. Spearheading the movement were Vietnam veterans and their advocates for whom the issue became a cause celebre, an avocation and a life's work. The absence of a parallel political force in Canada (notwithstanding efforts on behalf of organized groups from the United States and Canada to establish one) almost certainly minimizes the likelihood of public pressure to enact similar legislation here. In short, the Royal Commission is free to examine the options on their merits, without deference to political pressure from one source or another.

APPENDIX A

METHODOLOGY FOR POPULATION PROJECTIONS

APPENDIX A

METHODOLOGY FOR POPULATION PROJECTIONS

Most data from the TDC/HICKLING Transportation Information Base are derived from the 1986 Health and Activity Limitation (HALS) survey. Data tables from the information base are projected to the years 1990, 1995, or 2000 by population increases only. Other factors such as improved medical technology, "de-institutionalization" trends, and changes in travel patterns are not part of the projection methodology.

Future populations are based on Statistic Canada projections¹. These projections and their assumptions are discussed in Section A.1. Since Statistics Canada publishes only projections for the general population and not for the disabled population, one necessary assumption is that the incidence of disability by age does not change with time. For the projection of transportation disabled adults in households, HICKLING's predictive model is used; the predictive model is outlined in Section A.2. Technical details of the predictive model is given in Section A.6.

Sections A.3, A.4, and A.5 highlight details specific to projections for adults in households, children in households, and adults in institutions.

A.1 STATISTICS CANADA'S POPULATION PROJECTIONS

The population projections by age groups, for Canada and for Alberta, from Statistics Canada¹ are used. These projections are based on the regional cohort component approach. The first step of this approach is a separate analysis of previous trends in each component of population growth —fertility, mortality and migration (internal and international) — using the appropriate demographic parameters. The results of the trend analyses are then applied to the population of the base year to obtain the future population by age and sex for each region. The base population for the projections is the 1989 population estimates. National figures are aggregates of provincial and territorial projections.

Four projection series are published by Statistic Canada. They are based on different combinations of assumptions for the four factors which affect population growth:

- Fertility;
- Mortality;
- Migration — internal; and
- Migration — international.

Because of the recognized relationships between age and disabilities, the future number of seniors (age 65+) is an important factor in the of planning transportation services for disabled people. There is little difference between the four projection series when considering the future number of seniors. The cohorts who will make up this age group are already born. The projected senior population size varies only through migration assumptions. Nevertheless, the proportion of seniors will depend on the fertility assumption. For the years

1. Population Projections for Canada, Provinces and Territories, 1989-2011. Catalog number 91-520, Statistics Canada, March 1990.

leading up to 1988, the impact of immigration on the age structure of the population of Canada is, for all intents and purposes, nil².

In the ideal case, all four projections series should all be considered. It is however beyond the scope of the project to analyze all four projection scenarios; and the use of only one projection series will greatly simplify the interpretation of the large volume of data.

Series 1 was chosen as the final projection series for the following reasons:

- Extreme scenarios should not be used since we are investigating only one projection series. This criteria narrowed our choices to series 1 and series 3 because they are both medium growth scenarios for Alberta.
- We wanted a series with a migration pattern which is consistent with recent trends. The net migration of people into Alberta has increased consistently in the past four years, from a low of -20,000 between 1986-1987 to a high of +4,700 between 1989-1990. Series 1 assumes a partial return to westward migration. A telephone conversation with Mr. Frank Saulnier — Manager, Demographics and Employment Data, Canada Employment Centre, Edmonton — confirmed that there is some acceptance of this return to partial westward migration scenario in Alberta.

Other assumptions of series 1 projections include:

- Low fertility rate (number of births per woman declining from 1.67 in 1989 to 1.20 by 2011);
- Immigration level of 140,000; and
- Life expectancies at birth of 84.0 years for females and of 77.2 years for male.

A.2 PREDICTIVE MODEL FROM TRANSPORTATION INFORMATION BASE

The TDC/HICKLING Transportation Information Base (TIB) has a predictive model which can estimate the incidence of transportation disabilities and of its sub-sets:

- Transportation disabled (TD);
- Housebound;
- TD - Intercity;
- TD - Local;
- TD - Private Vehicle; and
- TD - Other.

2. Dumas, Jean; *Current Demographic Analysis, Report on the Demographic Situation in Canada, 1988*; Catalog 91-209E, Statistics Canada, 1990.

The input required for the model are:

- The proportions of the population in different age groups (20-49 years, 50-64 years, 65-79 years, and 80+ years);
- Province; and
- Large urban, other urban, or rural³.

For each run on the predictive model, the province, the transportation disability, and the urban/rural designation must be specified. Depending on the transportation disability of interest, only some of the age distribution data listed above may be required.

A.3 PROJECTIONS FOR ADULTS IN HOUSEHOLDS

Projection of Transportation Disabled Adults

To predict the number of adults in households who are transportation disabled requires: data from the TDC/HICKLING Transportation Information Base, Statistics Canada projections, and a predictive model in the Information Base. The predictive model estimates the incidence of transportation disability based on the age distribution of the population and on geographic regions. Technical details of the predictive model are included in Section A.6 of this appendix. A schematic representation of the projection process is depicted in Figure A-1.

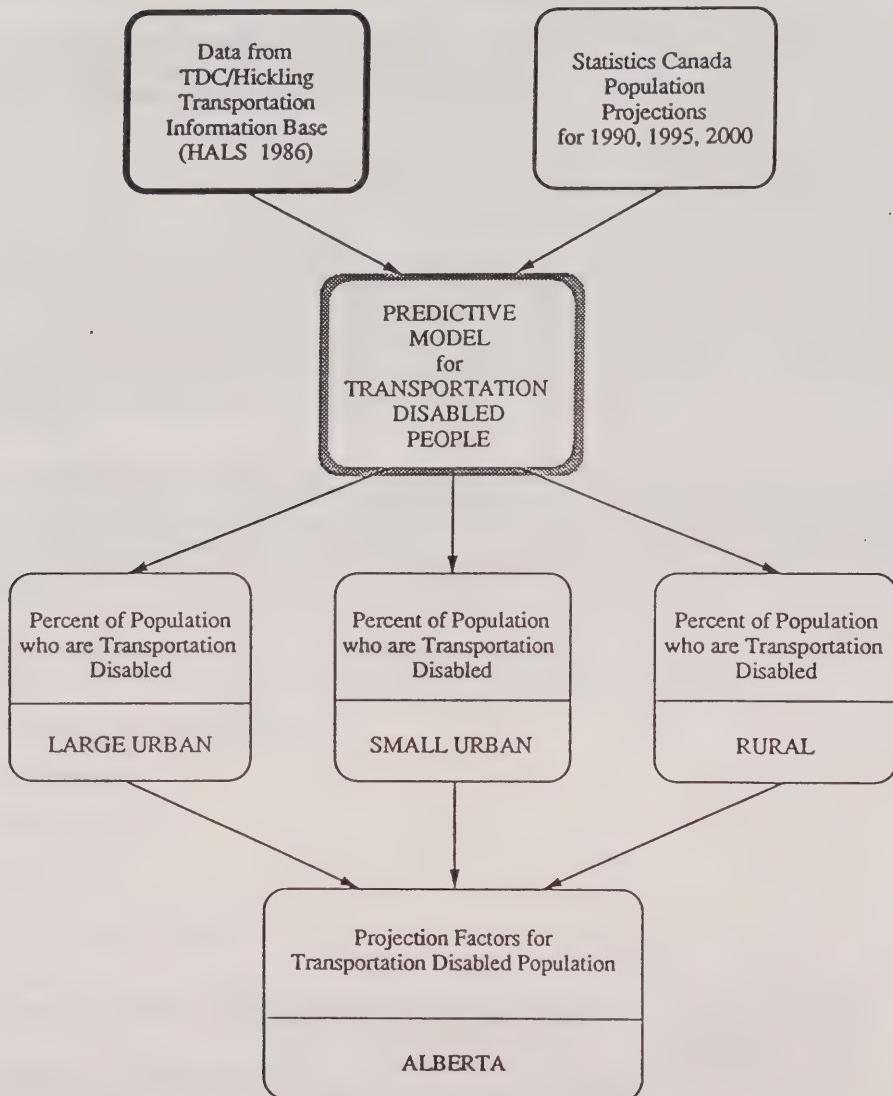
To project the number of transportation disabled people in Alberta for 1990, 1995, and the year 2000, the age distribution of adults in households is needed. For these years, population projections from Statistics Canada are used. Since the Statistics Canada projections are for all adults, they must be converted to adults in household. This conversion is performed by assuming that adults in household as a percentage of all adults (from 1986) remains constant.

3. Large urban is defined by the census metropolitan areas (CMA) identified by HALS: St. John's, Halifax, Montreal, Toronto, Winnipeg, Calgary, Edmonton, and Vancouver.

Other urban includes continuously built-up areas having population concentrations of 1,000 or more and a population density of 400 or more per square kilometre, based on previous census, and excluding the CMA's identified in large urban.

Rural refers to all territory lying outside urban areas.

FIGURE A-1
PROJECTION OF TRANSPORTATION DISABLED POPULATION
FROM 1986 DATA, ADULTS IN HOUSEHOLDS



The relationship between all adults and adults in households in 1986, for Alberta and for Canada, are shown in Table A-1. The population projection factors for household adults in Alberta, by age groups, for the years 1990, 1995, and 2000, are summarized in Table A-2.

Table A-1 Adults in Households in Relation to General Population (HALS 1986)

Description	Households Canada	Households Alberta	All Canada	All Alberta	Canada House/All Ratio	Alberta House/All Ratio
15-24 yrs	4,101,549	400,011	4,108,410	400,770	0.9983	0.9981
25-34 yrs	4,450,688	476,358	4,461,740	476,905	0.9975	0.9989
35-44 yrs	3,627,902	332,260	3,636,695	332,630	0.9976	0.9989
45-54 yrs	2,505,860	213,965	2,514,625	214,495	0.9965	0.9975
55-64 yrs	2,313,091	173,477	2,329,950	174,885	0.9928	0.9919
65-74 yrs	1,610,801	113,890	1,647,295	116,770	0.9778	0.9753
75-84 yrs	734,869	50,843	821,795	58,645	0.8942	0.8670
85+ yrs	139,104	7,931	215,570	14,930	0.6453	0.5312
Adults (15+)	19,483,864	1,768,735	19,736,080	1,790,030	0.9872	0.9881
Seniors (65+)	2,484,774	172,664	2,684,660	190,345	0.9255	0.9071

Table A-2 Projection Factors for Adults in Households by Age Groups in Alberta

Age Group	1986	1990	1995	2000
Total (15+)	1.000	1.051	1.144	1.239
15-34	1.000	0.966	0.943	0.936
35-54	1.000	1.145	1.380	1.570
55-64	1.000	1.063	1.154	1.344
65+	1.000	1.172	1.405	1.628

The Alberta population projections are then split between the various urban/rural regions. A fundamental assumption is that the urban/rural distribution (from 1986) for Alberta remains constant. The Alberta population projections, by age and by urban/rural regions are then processed by the predictive model to yield projection factors for the transportation disabled population. These projection factors by geographic regions are shown in Table A-3.

Table A-3 Projection Factors by Urban/Rural for Transportation Disabled Population, Household Adults, Alberta

Region	1986	1990	1995	2000
Large Urban	1.00	1.228	1.472	1.705
Small Urban	1.00	1.302	1.598	1.886
Rural	1.00	1.192	1.382	1.672
Alberta Total	1.00	1.240	1.488	1.743

A.4 PROJECTIONS FOR CHILDREN IN HOUSEHOLDS

Population projection factors for children in households in Alberta, based on Statistics Canada projections, are summarized in Table A-4⁴.

Table A-4 Projection Factors for Children in Households

Age Group	1986	1990	1995	2000
0 - 14 years	1.00	1.041	1.059	1.018
0 - 4 years	1.00	1.020	0.953	0.856
5 - 9 years	1.00	1.071	1.126	1.056
10 - 14 years	1.00	1.033	1.115	1.172

Assumptions of the data projections include:

- The incidence of the following — disability, transportation disability, housebound, TD-intercity, TD-local, vision/hearing/speaking troubles, and mental condition limiting activity — by age groups (0-4 yrs, 5-9 yrs, and 10-14 yrs) for 1986 is unchanged for the projection years.
- Disability and transportation characteristics of Alberta is similar to that of the West and Territories region (Man., Sask., Alta., B.C., Yukon, and N.W.T.). Some of the required data is not available at the provincial resolution and extrapolations based on the regional data, by age groups, are necessary. In 1986, Alberta accounted for 34% of the West and Territories region's child population.
- The urban/rural population split for Alberta is the same as that for the West and Territories region.
- All projections are based on population increases only. Changes in health or travel patterns are not considered.

4. Projection factors assumes that all children in Alberta live in households. This assumption was made after examining 1986 data for the Western Canada and Territories region. For all three age groups, at least 99.9% of the child population resided in households.

A.5 PROJECTIONS FOR ADULTS IN INSTITUTIONS

Projections of data related to adults in institution are based on population increases only. The proportion of the general population — by age groups — in institutions for 1986 is assumed for future projection years. Table A-5 shows the relationship between disabled adults in institutions and the general population for 1986, for Alberta and Canada.

Table A-5 Adults in Institutions in Relations to General Population (HALS 1986)

Description	Institution	Institution	All	Canada		Alberta	
	Canada	Alberta	Canada	All	Instns/All Ratio	Instns/All Ratio	
15-34 yrs	15,835	1,194	8,570,150	877,675	0.0018	0.0014	
35-54 yrs	15,973	861	6,151,320	547,125	0.0026	0.0016	
55-64 yrs	15,812	1,309	2,329,950	174,885	0.0068	0.0075	
65-74 yrs	35,355	2,820	1,647,295	116,770	0.0215	0.0242	
75-84 yrs	83,807	7,321	821,795	58,645	0.1020	0.1248	
85+ yrs	75,598	6,937	215,570	14,930	0.3507	0.4646	
Adults (15+)	242,379	20,443	19,736,080	1,790,030	0.0123	0.0114	
Seniors (65+)	194,759	17,078	2,684,660	190,345	0.0725	0.0897	

Table A-6 shows the projected populations of adults in institutions for the years 1990, 1995, and 2000. Table A-7 shows the corresponding projection factors, with 1986 as the base year.

Table A-6 Projected Population of Disabled Adults in Institutions

	1986	1986	1990	1990	1995	1995	2000	2000
	Canada	Alberta	Canada	Alberta	Canada	Alberta	Canada	Alberta
15-34	15,835	1,194	15,870	1,153	15,181	1,126	14,478	1,117
35-54	15,973	861	18,081	986	20,824	1,188	22,980	1,352
55-64	15,812	1,309	16,044	1,391	16,526	1,510	18,582	1,759
65-74	35,355	2,820	39,160	3,183	43,481	3,729	45,090	4,139
75-84	83,807	7,321	98,340	8,714	113,769	10,736	133,248	13,033
85+	75,598	6,937	96,334	9,571	124,179	12,592	160,966	16,866
Adults (15+)	242,379	20,443	283,829	24,999	333,960	30,881	395,344	38,266
Seniors (65+)	194,759	17,078	233,834	21,468	281,429	27,056	339,304	34,038

Table A-7 Projection Factors for Adults in Institutions

	1986 Canada	1986 Alberta	1990 Canada	1990 Alberta	1995 Canada	1995 Alberta	2000 Canada	2000 Alberta
Total (15+)	1.00	1.00	1.171	1.223	1.378	1.511	1.631	1.872
65+	1.00	1.00	1.201	1.257	1.445	1.584	1.742	1.993
15-34	1.00	1.00	1.002	0.966	0.959	0.943	0.914	0.936
35-54	1.00	1.00	1.132	1.145	1.304	1.380	1.439	1.570
55-64	1.00	1.00	1.015	1.063	1.045	1.154	1.175	1.344
65-74	1.00	1.00	1.108	1.129	1.230	1.322	1.275	1.468
75-84	1.00	1.00	1.173	1.190	1.358	1.466	1.590	1.780
85+	1.00	1.00	1.274	1.380	1.643	1.815	2.129	2.431

A.6 TECHNICAL DETAILS OF PREDICTIVE MODEL

The predictive model estimates the percentage of a local population with different transportation disabilities. The percentage with a given disability is estimated using the proportions of people falling into broad age categories, plus adjustments for regional variation in some provinces. The general form of the relationship is:

$$\begin{aligned} \text{\% with disability} = & \alpha + \beta_1(\text{\% of pop age in group 1}) \\ & + \beta_2(\text{\% of pop in age group 2}) \dots + \beta_i(\text{regional adj. factor}) \end{aligned}$$

where α and β_i are parameters provided by the Information Base.

To estimate α and β_i , an ordinary least squares (OLSQ) was used. This approach is most effective when relationships are linear. An alternative non-linear approach (Logit), was tested and rejected. Non-linear approaches like Logit have the advantage of ensuring that one never forecasts less than 0% or more than 100%. However, the OLSQ approach provided more accurate results than Logit and did not exceed the realistic range of forecasts.

Alternative demographic variables to age groups were also tested. Variables such as income, family income, family size and education all proved to have statistically significant relationships to incidence of disability. However, age groups had by far the highest predictive ability. For example, when age groups were included in the equations, adding average income or other variables did not appreciably improve the accuracy. Therefore, we were able to exclude demographic variables other than age from the equations without sacrificing accuracy. This is a significant benefit to users because it minimizes the information they must provide to use the predictive model.

To obtain the OLSQ estimate, the records in the HALS data base were divided into approximately 150 groups, representing 50 major urban groups, 50 urban groups, and 50 rural groups. Each group came from a specific province. An equation was estimated for each of major urban, urban, and rural for each of the five types of transportation disability. Therefore, there were (3*5=15) total possible equations. Of these possibilities, statistically valid equations were found for 11 cases. The four exceptions were for rural areas, where no statistically significant relationship was found between the incidence of transportation disability and demographic variables.

To be acceptable, the equations generated by OLSQ had to meet a 95% level of confidence (i.e. a 5% chance that the relationship is not valid). The equations were also checked to see if they predicted the average incidence of disability per province well, compared to the actual incidence reported in the HALS survey. Accuracy of equations was acceptable, but not high, averaging plus or minus 10% when predicting incidence by province. The Information Base will include an adjustment to account for any bias by province. For example, where the equations overestimate incidence by 5%, the forecast amount provided to the user will be reduced by 5%.

For the rural cases where no valid equation was found, the predictive model will use average incidence of transportation disability reported for rural areas in the user's province. For example, there is a rural incidence of homebound in Ontario of 0.68%. The predictive model will assume that any Ontario rural locality has an incidence of homebound of 0.68% of the population.

The Yukon and Northwest territories were excluded from estimation because of the wide difference in incidence of transportation disability reported there. Part of this discrepancy may result from different interpretations of the meaning of the questions by survey respondents. For example, a large number (89.43%) of Yukon respondents fell into the intercity transportation disability category.

In general, the most significant variable driving the predictive model is the proportion of the population age 65 and older. In some cases, this age group alone is all the information that is required. In other cases, it was found more effective to divide the group in two, age 65 to 79 and age 80 and over. The impact of age groups varied between rural, urban, and major urban. In the clearest example, a significantly lower percentage of the 80+ age group had difficulty using a personal vehicle in the major urban areas than in the rural or urban areas. The pattern of incidence also varies between provinces. Homebound in Ontario, for example, display a preference for locating in major urban areas rather than urban areas to a greater degree than the rest of the country.

